

UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE PATENT TRIAL AND APPEAL BOARD

Case No. IPR2024-00948

U.S. Patent No. 11,050,097

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ASCEND ELEMENTS, INC.,

Petitioner,

- against -

DUESENFELD GMBH.

Patent Owner.

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June 6, 2025

10:31 a.m.

VIDEOTAPED DEPOSITION of DR. WALTER VAN  
SCHALKWIJK , held at the offices of ROBINS  
KAPLAN LLP, located at 1325 Avenue of the  
Americas, New York, New York 10019, before  
Anthony Giarro, a Registered Professional  
Reporter, a Certified Realtime Reporter and a  
Notary Public of the State of New York.

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| <p style="text-align: right;">Page 2</p> <p>1<br/>2 APPEARANCES:<br/>3<br/>4 GISH PLLC<br/>5 Attorneys for Petitioner<br/>6 41 Madison Avenue<br/>7 New York, New York 10010<br/>8<br/>9 BY: JOSEF B. SCHENKER, ESQ.<br/>10 josef.schenker@gishpllc.com<br/>11 CONOR B. McDONOUGH, ESQ.<br/>12 conor.mcdonough@gishpllc.com<br/>13 (via Zoom)<br/>14<br/>15 ROBINS KAPLAN LLP<br/>16 Attorneys for Patent Owner<br/>17 800 LaSalle Avenue, Suite 2800<br/>18 Minneapolis, Minnesota 55402<br/>19<br/>20 BY: TRAVIS K. WALLER, ESQ.<br/>21 twaller@robinskaplan.com<br/>22 STEVEN C. CARLTON, ESQ.<br/>23 scarlson@robinskaplan.com<br/>24 (via Zoom)<br/>25<br/>26 ROBINS KAPLAN LLP<br/>27 Attorneys for Patent Owner<br/>28 555 Twin Dolphin Drive, Suite 310<br/>29 Redwood City, California 94065<br/>30 BY: BELLE BOROVIK, ESQ.<br/>31 bborovik@robinskaplan.com<br/>32 (via Zoom)<br/>33<br/>34 ALSO PRESENT:<br/>35 BOB RUDIS, Videographer<br/>36 ETHAN GROSS, Summer<br/>37 Associate, Robins Kaplan<br/>38 VANI DANTAM<br/>39 (via Zoom)<br/>40<br/>41<br/>42<br/>43<br/>44<br/>45</p> | <p style="text-align: right;">Page 4</p> <p>1<br/>2 My name is Bob Rudis. I'm<br/>3 the videographer. The court reporter<br/>4 is Anthony Giarro. And we represent<br/>5 the firm Veritext Legal Solutions.<br/>6 I am not authorized to<br/>7 administer an oath, I'm not related<br/>8 to any party in this action, nor am I<br/>9 financially interested in the<br/>10 outcome.<br/>11 If there are any objections<br/>12 to proceeding, please state them at<br/>13 the time of your appearance.<br/>14 Counsel will now state their<br/>15 appearances and affiliations for the<br/>16 record, beginning with the noticing<br/>17 attorney.<br/>18 MR. WALLER: Good morning.<br/>19 My name is Travis Waller. I'm with<br/>20 the law firm of Robins Kaplan LLP. I<br/>21 represent the patent owner in this<br/>22 matter, Duesenfeld GmbH. I'm also<br/>23 joined with our summer associate,<br/>24 Ethan Gross.<br/>25 MR. SCHENKER: Good morning.</p> |
| <p style="text-align: right;">Page 3</p> <p>1<br/>2 THE VIDEOGRAPHER: Good<br/>3 morning. We are going on the record<br/>4 at 10:31 a.m. on June 6th, 2025.<br/>5 Please note the microphones are<br/>6 sensitive and may pick up whispering<br/>7 and private conversations. Please<br/>8 mute your mobile phones at this time.<br/>9 Audio and video recording will<br/>10 continue to take place unless all<br/>11 parties agree to go off the record.<br/>12 This is Media Unit 1 of the<br/>13 video-recorded deposition of Dr.<br/>14 Walter Van Schalkwijk, taken by<br/>15 counsel for Patent Owner, in the<br/>16 matter of Ascend Elements, Inc.<br/>17 versus Duesenfeld GMBH.<br/>18 This case is filed in the<br/>19 United States Patent and Trademark<br/>20 Office before the Patent Trial and<br/>21 Appeal Board, Case No. IPR2024-00948,<br/>22 U.S. Patent No. 11,050,097.<br/>23 The location of the<br/>24 deposition is Robins Kaplan LLP, 1325<br/>25 6th Avenue, New York, New York 10019.</p>                                                                          | <p style="text-align: right;">Page 5</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 Josef Schenker from Gish PLLC on<br/>3 behalf of Petitioner Ascend Elements<br/>4 Incorporated.<br/>5 THE VIDEOGRAPHER: Would the<br/>6 people on Zoom please announce<br/>7 yourselves?<br/>8 MR. McDONOUGH: Conor<br/>9 McDonough, also with Gish, on behalf<br/>10 of defendants.<br/>11 MS. BOROVIK: Belle Borovik,<br/>12 Robins Kaplan, on behalf of<br/>13 plaintiffs.<br/>14 MR. DANTAM: Vani Dantam on<br/>15 behalf of Duesenfeld.<br/>16 THE VIDEOGRAPHER: Would the<br/>17 please swear in the witness, and then<br/>18 counsel may proceed.<br/>19 D R. W A L T E R V A N S C H A L K W I J K,<br/>20 after having first been duly sworn by a<br/>21 Notary Public of the State of New York, was<br/>22 examined and testified as follows:<br/>23 EXAMINATION BY<br/>24 MR. WALLER:<br/>25 Q Could you please state your</p>                                        |

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| <p style="text-align: right;">Page 6</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 full name for the record?</p> <p>3 A Walter A. van Schalkwijk.</p> <p>4 Q What is your home address?</p> <p>5 A 14312 279th Place Northeast,</p> <p>6 Duvall, Washington 98019.</p> <p>7 Q May I call you Dr. van</p> <p>8 Schalkwijk throughout this deposition?</p> <p>9 A Sure.</p> <p>10 Q Are you under the influence</p> <p>11 of any drugs or medications which may</p> <p>12 impair your ability to answer my</p> <p>13 questions fully and truthfully?</p> <p>14 A I am not.</p> <p>15 Q Do you suffer from any</p> <p>16 medical or mental or emotional condition</p> <p>17 which may impair or impede your ability</p> <p>18 to answer my questions fully and</p> <p>19 truthfully today?</p> <p>20 A I do not.</p> <p>21 Q Have you been deposed at all</p> <p>22 since your last deposition in this IPR?</p> <p>23 A Not on this IPR. I've been</p> <p>24 deposed in another matter.</p> <p>25 Q Could you explain that</p> | <p style="text-align: right;">Page 8</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q If you do not hear or</p> <p>3 understand any of my questions, please</p> <p>4 let me know. If you answer a question, I</p> <p>5 will assume that you've heard it and</p> <p>6 understood it and have answered it</p> <p>7 completely and accurately. Do you</p> <p>8 understand?</p> <p>9 A I understand.</p> <p>10 Q Please let me finish my</p> <p>11 questions before you begin an answer, so</p> <p>12 that the court reporter can transcribe</p> <p>13 what is being said. If an answer is yes</p> <p>14 or no, please say yes or no so the court</p> <p>15 reporter can transcribe your answer. Do</p> <p>16 you understand?</p> <p>17 A I understand.</p> <p>18 Q If you need a break at any</p> <p>19 time, please let me know. Just be aware</p> <p>20 that you may not take a break while there</p> <p>21 is any question pending. Do you</p> <p>22 understand?</p> <p>23 A I understand.</p> <p>24 Q I'd like to begin with</p> <p>25 getting some terminology down.</p> |
| <p style="text-align: right;">Page 7</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 matter for me briefly?</p> <p>3 A That matter is a --</p> <p>4 MR. SCHENKER: Object to</p> <p>5 form.</p> <p>6 A That matter is a contract</p> <p>7 dispute between a large electronics</p> <p>8 conglomerate and a battery pack</p> <p>9 manufacturer.</p> <p>10 Q Could you identify the</p> <p>11 parties in that matter?</p> <p>12 MR. SCHENKER: Objection to</p> <p>13 form.</p> <p>14 A The battery pack</p> <p>15 manufacturer is a Chinese manufacturer,</p> <p>16 TWS, and the large conglomerate is</p> <p>17 Resideo, formally ADT, the security</p> <p>18 company.</p> <p>19 Q I'd like to go over some</p> <p>20 ground rules for the deposition today as</p> <p>21 well. I'll be asking you questions. You</p> <p>22 must answer the questions completely and</p> <p>23 truthfully and accurately. Do you</p> <p>24 understand?</p> <p>25 A I do.</p>                                                                      | <p style="text-align: right;">Page 9</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 If I refer to Ascend</p> <p>3 Elements Incorporated as just Ascend,</p> <p>4 will you know what I'm talking about?</p> <p>5 A Yes.</p> <p>6 Q If I refer to Duesenfeld</p> <p>7 GmbH as just Duesenfeld, will you know</p> <p>8 who I'm discussing?</p> <p>9 A Yes.</p> <p>10 Q If I refer to U.S. Patent</p> <p>11 No. 9780419 as the Hanisch reference or</p> <p>12 Hanisch, will you understand what I'm</p> <p>13 referring to?</p> <p>14 A Yes.</p> <p>15 Q If I refer to U.S. Patent</p> <p>16 No. 9450277 as the Dunagan reference or</p> <p>17 Dunagan, will you understand what I'm</p> <p>18 referring to?</p> <p>19 A Yes.</p> <p>20 Q If I refer to U.S. Patent</p> <p>21 No. 9843077 as the Hayashi reference or</p> <p>22 Hayashi, will you understand what I'm</p> <p>23 referring to?</p> <p>24 A Yes.</p> <p>25 Q If I refer to U.S. Patent</p>                                                                                                                       |

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| <p style="text-align: right;">Page 10</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 No. 10396408 as the Shin reference or</p> <p>3 Shin, will you understand what I'm</p> <p>4 referring to?</p> <p>5 A Yes.</p> <p>6 Q And if I refer to U.S.</p> <p>7 Patent No. 5632863 as the Medior</p> <p>8 reference or Medior, will you understand</p> <p>9 what I'm referring to?</p> <p>10 A Yes.</p> <p>11 Q You submitted a declaration</p> <p>12 in support of Ascend's reply to</p> <p>13 Duesenfeld's patent owner response;</p> <p>14 correct?</p> <p>15 A Yes.</p> <p>16 Q And the same declaration</p> <p>17 also contains your opinions in support of</p> <p>18 Ascend's opposition, Duesenfeld's</p> <p>19 contingent motion to amend; correct?</p> <p>20 A Yes.</p> <p>21 Q And you're here today to</p> <p>22 testify about both of those opinions;</p> <p>23 correct?</p> <p>24 MR. SCHENKER: Objection,</p> <p>25 form.</p> | <p style="text-align: right;">Page 12</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Did anyone at Ascend assist</p> <p>3 you in preparing this declaration?</p> <p>4 A No.</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 form.</p> <p>7 Q Did anyone at the law firm</p> <p>8 of Gish PLLC assist you in preparing your</p> <p>9 declaration?</p> <p>10 MR. SCHENKER: Objection,</p> <p>11 form.</p> <p>12 A Not in the content, only in</p> <p>13 the structure.</p> <p>14 Q Have you spoken with any of</p> <p>15 the authors of any of the prior art</p> <p>16 references asserted in this IPR in</p> <p>17 preparing this declaration?</p> <p>18 A I have not.</p> <p>19 Q How about in preparation for</p> <p>20 this deposition?</p> <p>21 A I have not.</p> <p>22 Q Have you spoken with any</p> <p>23 individuals, directly or indirectly,</p> <p>24 affiliated with URT, Umwelt-und</p> <p>25 Recyclingtechnik, GmbH in preparing for</p> |
| <p style="text-align: right;">Page 11</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A I'm here to testify about</p> <p>3 what's in my declaration, my second</p> <p>4 declaration.</p> <p>5 Q Understood.</p> <p>6 A All of it.</p> <p>7 Q Who prepared your</p> <p>8 declaration?</p> <p>9 A I prepared the contents.</p> <p>10 Putting it into legal format was done by</p> <p>11 the law firm.</p> <p>12 Q How many hours did you spend</p> <p>13 working on the declaration?</p> <p>14 A I haven't added that up yet.</p> <p>15 I would really like to do that soon so I</p> <p>16 could send an invoice. I haven't done</p> <p>17 that yet.</p> <p>18 Q Do you have a rough</p> <p>19 estimate?</p> <p>20 A No.</p> <p>21 Q Would it be under 50 hours?</p> <p>22 A Yes.</p> <p>23 Q Under 30 hours?</p> <p>24 A In between those two</p> <p>25 numbers.</p>                                                                   | <p style="text-align: right;">Page 13</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 this declaration?</p> <p>3 A I have not.</p> <p>4 Q How about in preparing for</p> <p>5 this deposition?</p> <p>6 A I have not.</p> <p>7 Q You opine in your</p> <p>8 declaration that a POSITA would have</p> <p>9 understood the dry cell fragments formed</p> <p>10 by Hanisch's pre-dryer to have to be</p> <p>11 fully dry and inactivated; is that</p> <p>12 correct?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form.</p> <p>15 A That was what I've written.</p> <p>16 And that's how it is set forth in</p> <p>17 Hanisch.</p> <p>18 Q So I'm not sure if that</p> <p>19 answers my question.</p> <p>20 Is it your opinion that a</p> <p>21 POSITA would have understood the dry cell</p> <p>22 fragments formed by Hanisch's pre-dryer</p> <p>23 to have to be fully dry and inactivated?</p> <p>24 MR. SCHENKER: Objection,</p> <p>25 form.</p>  |

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| <p style="text-align: right;">Page 14</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A A POSITA looking at Hanisch</p> <p>3 and seeing fully dry and inactivated</p> <p>4 would have had the conclusion that the</p> <p>5 material is inactivated.</p> <p>6 Q And you base this on</p> <p>7 language, dry cell fragments, in Hanisch;</p> <p>8 correct?</p> <p>9 MR. SCHENKER: Objection,</p> <p>10 form.</p> <p>11 A I do.</p> <p>12 Q And it's your understanding</p> <p>13 that the dry cell fragment language in</p> <p>14 Hanisch is referring to the battery</p> <p>15 fragments leaving Hanisch's pre-dryer;</p> <p>16 right?</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form.</p> <p>19 A Yes.</p> <p>20 Q Hanisch teaches that a</p> <p>21 battery is rendered into fragments by a</p> <p>22 cell-crushing device; correct?</p> <p>23 MR. SCHENKER: Objection,</p> <p>24 form.</p> <p>25 A I believe that's correct,</p>                | <p style="text-align: right;">Page 16</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 processes.</p> <p>3 Q But Hanisch teaches that the</p> <p>4 batteries enter the cell crusher, get</p> <p>5 crushed and then go to the pre-dryer;</p> <p>6 right?</p> <p>7 MR. SCHENKER: Objection,</p> <p>8 form.</p> <p>9 A After being discharged.</p> <p>10 Q Hanisch also illustrates</p> <p>11 that the battery fragments travel in</p> <p>12 certain separators and classifiers after</p> <p>13 this pre-dryer; correct?</p> <p>14 A Yes.</p> <p>15 MR. SCHENKER: Objection,</p> <p>16 form.</p> <p>17 Q And you base your opinion</p> <p>18 that the cell fragments leaving the</p> <p>19 pre-dryer must be fully dry and</p> <p>20 inactivated due to the existence of these</p> <p>21 separators and classifiers; right?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A Restate that question.</p> <p>25 Q Certainly.</p>                                                                                                            |
| <p style="text-align: right;">Page 15</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 yes.</p> <p>3 Q Would a POSITA have known to</p> <p>4 discharge the batteries before putting</p> <p>5 them in this cell-crushing device?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, scope.</p> <p>8 A Yes.</p> <p>9 Q A POSITA would never do this</p> <p>10 to mitigate the dangers associated with</p> <p>11 commuting charged batteries; correct?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form --</p> <p>14 A Yes.</p> <p>15 MR. SCHENKER: -- scope of</p> <p>16 the deposition.</p> <p>17 Q Is it your understanding</p> <p>18 that Hanisch teaches a system where the</p> <p>19 batteries go to the cell-crushing device,</p> <p>20 are then crushed and then go to the</p> <p>21 pre-dryer?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A The batteries get discharged</p> <p>25 first before going through these other</p> | <p style="text-align: right;">Page 17</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 You base your opinion that</p> <p>3 the cell fragments leaving the pre-dryer</p> <p>4 must be fully dry and inactivated due to</p> <p>5 the existence of these separators and</p> <p>6 classifiers; correct?</p> <p>7 MR. SCHENKER: Objection,</p> <p>8 form.</p> <p>9 A The material is dry and</p> <p>10 inactive. What happens with the dryers</p> <p>11 and separators is a different process.</p> <p>12 Q You recall talking about a</p> <p>13 classifier in your declaration; correct?</p> <p>14 A Yes.</p> <p>15 MR. SCHENKER: Objection.</p> <p>16 Q Which classifier are you</p> <p>17 talking about?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 form, lacks foundation.</p> <p>20 A There are zig-zag</p> <p>21 classifiers, there are eddy current</p> <p>22 classifiers, and there are magnetic</p> <p>23 classifiers. And they're designed to</p> <p>24 remove certain materials, ferrous</p> <p>25 materials or non-ferrous materials and</p> |

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| <p style="text-align: right;">Page 18</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 the like. But it's designed to separate</p> <p>3 out some of the materials for further</p> <p>4 processing.</p> <p>5 Q Let's take them one at a</p> <p>6 time.</p> <p>7 You mentioned a zig-zag</p> <p>8 classifier. What is a zig-zag</p> <p>9 classifier?</p> <p>10 A A zig-zag classifier, some</p> <p>11 would call it a shake table. But it's a</p> <p>12 process where the material is shaken back</p> <p>13 and forth, so the particles can then be</p> <p>14 moving through of a certain size and</p> <p>15 recovered separately.</p> <p>16 Q And you mentioned an eddy</p> <p>17 current separator; correct?</p> <p>18 A Yes.</p> <p>19 Q What is that?</p> <p>20 A That will -- an eddy current</p> <p>21 is sort of a magnetic field, an</p> <p>22 electric -- sort of an AC field as</p> <p>23 opposed to just a static magnetic field.</p> <p>24 And it will allow for separation of</p> <p>25 non-ferrous materials like aluminum and</p> | <p style="text-align: right;">Page 20</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 would have a coil. And you would put an</p> <p>3 AC frequency into that. And it would</p> <p>4 generate a non-static frequency-dependent</p> <p>5 magnetic field that could be used for</p> <p>6 detecting and segregating certain</p> <p>7 materials.</p> <p>8 Q Taking the zig-zag</p> <p>9 classifier, it's your opinion that</p> <p>10 passing wet and active battery fragments</p> <p>11 through this de-classifier would be</p> <p>12 dangerous; right?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form, mischaracterizes the</p> <p>15 declaration.</p> <p>16 A I didn't say they would be</p> <p>17 dangerous. I said that it would be</p> <p>18 troublesome for the classifier to operate</p> <p>19 if wet materials went through them.</p> <p>20 Q Could you explain how it</p> <p>21 would be troublesome?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A If a material is still wet</p> <p>25 or moist, there's a tendency, due to</p> |
| <p style="text-align: right;">Page 19</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 copper. So any of the particles</p> <p>3 containing aluminum and copper can be</p> <p>4 segregated by the eddy current.</p> <p>5 Q You also mentioned a</p> <p>6 magnetic separator; correct?</p> <p>7 A Yes.</p> <p>8 Q And what is that?</p> <p>9 A That would allow the</p> <p>10 collection and separation of magnetic</p> <p>11 materials, intrinsically magnetic</p> <p>12 materials.</p> <p>13 Q So the eddy current</p> <p>14 separator and the magnetic separator are</p> <p>15 different separators?</p> <p>16 MR. SCHENKER: Objection,</p> <p>17 form, mischaracterizes testimony.</p> <p>18 A The magnetic fields -- the</p> <p>19 magnetic separator is a static magnetic</p> <p>20 field, just like you would have from a</p> <p>21 magnet. An eddy current separator</p> <p>22 generally operates on a</p> <p>23 frequency-dependent magnetic field</p> <p>24 generated by a coil.</p> <p>25 So you would put -- you</p>                 | <p style="text-align: right;">Page 21</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 colligative properties between the</p> <p>3 solvents and the particles, for particles</p> <p>4 to clump together. And if it clumps</p> <p>5 together, it's hard for the zig-zag</p> <p>6 separator to do its work.</p> <p>7 Q You also state in your</p> <p>8 declaration, "However, active lithium-ion</p> <p>9 battery materials contain volatile</p> <p>10 electrolytes that can ignite if exposed</p> <p>11 to heat or friction during</p> <p>12 classification"; correct?</p> <p>13 MR. SCHENKER: Objection.</p> <p>14 A Say that again just to be</p> <p>15 clear.</p> <p>16 Q You state in your</p> <p>17 declaration, "However, active lithium-ion</p> <p>18 battery materials contain volatile</p> <p>19 electrolytes that can ignite if exposed</p> <p>20 to heat or friction during</p> <p>21 classification."</p> <p>22 You recall writing that?</p> <p>23 A I recall that.</p> <p>24 Q Is that still your opinion</p> <p>25 today?</p>                  |

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| <p style="text-align: right;">Page 22</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A It is my opinion.</p> <p>3 Q You also state that</p> <p>4 "Lithium-ion batteries are prone to</p> <p>5 thermal runaway, a chain reaction of</p> <p>6 uncontrolled heating that can lead to</p> <p>7 fire or explosion."</p> <p>8 Do you recall writing that</p> <p>9 in your declaration?</p> <p>10 A Yes. But you're leaving</p> <p>11 some incompleteness there.</p> <p>12 Q What incompleteness do you</p> <p>13 believe that I'm leaving out?</p> <p>14 A It just doesn't happen like</p> <p>15 spontaneously. It happens under certain</p> <p>16 conditions.</p> <p>17 Q And one of the conditions</p> <p>18 you mentioned is friction; correct?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form, mischaracterizes the</p> <p>21 declaration.</p> <p>22 A Friction will generate heat.</p> <p>23 Heat in some cases, if all the materials</p> <p>24 are present, can cause a thermal runaway.</p> <p>25 But if you passed your material through</p>                                                                                                  | <p style="text-align: right;">Page 24</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A In the zig-zag classifier,</p> <p>3 if you're going to be generating heat,</p> <p>4 it's generally because of friction</p> <p>5 between the particles. And friction and</p> <p>6 that static electricity comes from dry</p> <p>7 particles, not wet particles. What would</p> <p>8 happen if you had clumped particles that</p> <p>9 are wet, your classifier probably would</p> <p>10 just get clogged up. And there wouldn't</p> <p>11 be much friction because nothing would be</p> <p>12 moving.</p> <p>13 Q You state in your</p> <p>14 declaration, "Classifiers are used to</p> <p>15 separate materials based on size and</p> <p>16 density. However, active lithium-ion</p> <p>17 battery materials contain volatile</p> <p>18 electrolytes that can ignite if exposed</p> <p>19 to heat or friction during</p> <p>20 classification. Further, lithium</p> <p>21 batteries are prone to thermal runaway, a</p> <p>22 chain reaction of uncontrolled heating</p> <p>23 that can lead to fire or explosion."</p> <p>24 Do you remember writing</p> <p>25 that?</p> |
| <p style="text-align: right;">Page 23</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 the batteries being discharged, then</p> <p>3 crushed, then comminuted and then put</p> <p>4 through the pre-dryer, they're dry.</p> <p>5 There's no electrolyte present to</p> <p>6 propagate any reaction that might occur.</p> <p>7 So the chance of an</p> <p>8 electrochemical reaction that could lead</p> <p>9 to any kind of battery-simulated reaction</p> <p>10 with electrons passing, ions passing and</p> <p>11 then so-called thermal runaway, it would</p> <p>12 just be very, very unlikely if you have</p> <p>13 done the all the previous steps, the</p> <p>14 crushing, the comminution and the</p> <p>15 pre-dryer properly. Then friction</p> <p>16 becomes something that you're not</p> <p>17 concerned about because you do not have</p> <p>18 any liquid electrolyte present.</p> <p>19 Q Understood.</p> <p>20 However, if you're passing</p> <p>21 wet and active battery fragments into a</p> <p>22 zig-zag classifier, that can cause</p> <p>23 thermal runaway; correct?</p> <p>24 MR. SCHENKER: Objection,</p> <p>25 form.</p> | <p style="text-align: right;">Page 25</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form.</p> <p>4 A I do.</p> <p>5 Q Now, what I'm asking you is</p> <p>6 that if you pass active battery</p> <p>7 fragments, active wet battery fragments</p> <p>8 into the zig-zag classifier, will they</p> <p>9 cause thermal runaway?</p> <p>10 MR. SCHENKER: Objection,</p> <p>11 form, incomplete hypothetical,</p> <p>12 mischaracterizes his declaration.</p> <p>13 A They're not likely to</p> <p>14 generate enough heat to cause this kind</p> <p>15 of reaction to take place because since</p> <p>16 they are wet particles, they're not going</p> <p>17 to create the static electricity that you</p> <p>18 would need to generate the heat, the</p> <p>19 heat.</p> <p>20 Q You also write, "In</p> <p>21 addition, many classifiers or separators</p> <p>22 use high-speed airflows or rotating parts</p> <p>23 which could generate sparks or heat</p> <p>24 sufficient to ignite materials,</p> <p>25 especially if the particles are fine and</p>                                                                        |

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| <p style="text-align: right;">Page 26</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 dried out mid process."<br/>3 Is this correct?<br/>4 MR. SCHENKER: Objection to<br/>5 form.<br/>6 A I wrote that, yes.<br/>7 Q And is that your opinion<br/>8 today?<br/>9 A I qualify it by saying that,<br/>10 yes, there's heat generated. But there's<br/>11 no liquid electrolyte present to<br/>12 propagate any reaction that might occur.<br/>13 So you might just have warm material<br/>14 coming through and not any cause for a<br/>15 chemical -- an electrochemical reaction<br/>16 or a thermal runaway.<br/>17 Q Let me ask it this way.<br/>18 Is passing active wet<br/>19 battery fragments through a zig-zag<br/>20 separator dangerous?<br/>21 MR. SCHENKER: Objection,<br/>22 form, incomplete hypothetical.<br/>23 A Because of the clumping<br/>24 condition that I mentioned earlier, I<br/>25 don't think materials would pass through</p> | <p style="text-align: right;">Page 28</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 understood the fact that battery material<br/>3 goes from the pre-dryer to the separators<br/>4 and classifier, means that the battery<br/>5 material must have been fully dried to<br/>6 the point of inactivation. This is for<br/>7 the simple reasons that the separator and<br/>8 classifier, One, would not work<br/>9 effectively with still wet particles,<br/>10 and, Two, would be dangerous to use with<br/>11 still active battery material."<br/>12 Do you recall writing that?<br/>13 MR. SCHENKER: Objection,<br/>14 form.<br/>15 A I do. I wrote that.<br/>16 Q And is that still your<br/>17 opinion today?<br/>18 A But the material would not<br/>19 pass through. The material is still wet,<br/>20 could pose some problems. But the<br/>21 material, if it has properly gone through<br/>22 the pre-dryer, materials are dry and<br/>23 inactivated. And they would present no<br/>24 issue as far as any danger.<br/>25 Q But you state here that a</p> |
| <p style="text-align: right;">Page 27</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 the zig-zag separator -- the classifier.<br/>3 They would clog the classifier.<br/>4 Q That doesn't answer my<br/>5 question.<br/>6 Would passing active battery<br/>7 fragments through a zig-zag classifier be<br/>8 dangerous?<br/>9 MR. SCHENKER: Objection,<br/>10 form.<br/>11 A What do you mean by active?<br/>12 Q Are you unfamiliar with the<br/>13 word, active, in this context?<br/>14 MR. SCHENKER: Objection,<br/>15 form.<br/>16 A You seem to be redefining<br/>17 it. If the material has been dried, it's<br/>18 not active. It's inactivated. So you<br/>19 should be looking backwards toward<br/>20 your -- your drying process in the<br/>21 pre-dryer if you think that you're<br/>22 getting wet material coming through to<br/>23 the classifier.<br/>24 Q Your direct testimony in<br/>25 this matter is, "A POSITA would have</p>       | <p style="text-align: right;">Page 29</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 POSITA would have understood that running<br/>3 active battery material through the<br/>4 separators and classifier that you<br/>5 identify would be dangerous; correct?<br/>6 MR. SCHENKER: Objection,<br/>7 form.<br/>8 A Did I say dangerous or<br/>9 present some danger?<br/>10 Q You said would be dangerous.<br/>11 I'm happy to show you your declaration if<br/>12 you'd like to refresh your memory.<br/>13 A I would like to see it.<br/>14 MR. WALLER: I'm showing the<br/>15 witness a document that's been<br/>16 previously marked as Exhibit 1023 in<br/>17 this IPR.<br/>18 Q I would like to direct you<br/>19 to paragraph 15. I encourage you to read<br/>20 all of paragraph 15.<br/>21 A I am.<br/>22 Q However, what I've been<br/>23 asking you about is Roman Numeral II on<br/>24 page 7.<br/>25 A Yes. I wrote that. And,</p>                                                                                                                       |

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| <p style="text-align: right;">Page 30</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 yes, I stand by it. But if -- depending</p> <p>3 on the dimensions of the classifier and</p> <p>4 the zig-zag, you had enough there to</p> <p>5 generate some heat. Again, you're not</p> <p>6 going to generate the heat, unless you</p> <p>7 have some friction. If the materials are</p> <p>8 moist, not wet, there might be some heat</p> <p>9 generated.</p> <p>10 But certainly, that would be</p> <p>11 of a concern to a POSITA and anybody</p> <p>12 operating this equipment. Operating the</p> <p>13 equipment at this point and going from</p> <p>14 the dry cell fragments from the pre-dryer</p> <p>15 and into the classifiers assumes that the</p> <p>16 cell fragments are dry. And if they are</p> <p>17 wet, then you have not operated your</p> <p>18 pre-dryer correctly, unless you could be</p> <p>19 creating yourself a danger; however</p> <p>20 unlikely.</p> <p>21 Q Could you elaborate on what</p> <p>22 sort of dangers you would be creating?</p> <p>23 MR. SCHENKER: Objection,</p> <p>24 form.</p> <p>25 A If the material is moist,</p>      | <p style="text-align: right;">Page 32</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Could it create the</p> <p>3 formation of hydrogen fluoride gas?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form, incomplete hypothetical.</p> <p>6 A If wet electrolyte is coming</p> <p>7 through, but you have moisture, like</p> <p>8 water moisture, then you could create</p> <p>9 some HF, but very, very unlikely, because</p> <p>10 during the drying in the pre-dryer, and</p> <p>11 you're drying it at a temperature, so</p> <p>12 that you don't generate -- you minimize</p> <p>13 the creation of HF, I don't think there's</p> <p>14 anything left for you to generate HF with</p> <p>15 when you are in the classifier.</p> <p>16 Q So I guess I'm not</p> <p>17 understanding what's dangerous about the</p> <p>18 passage of wet battery material through a</p> <p>19 zig-zag classifier.</p> <p>20 If your testimony is that</p> <p>21 there will be no explosion and minimal</p> <p>22 amounts of hydrogen fluoride gas creation</p> <p>23 and only minimal amounts of heat created,</p> <p>24 what is the danger then?</p> <p>25 MR. SCHENKER: Objection,</p>                                                       |
| <p style="text-align: right;">Page 31</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 you could probably cause a little bit of</p> <p>3 battery reaction to take place, but not</p> <p>4 to the extent that you could have a</p> <p>5 thermal runaway in this situation. You</p> <p>6 might generate some battery voltage and</p> <p>7 some extra heat from that.</p> <p>8 Q Could this cause fires?</p> <p>9 A Unlikely, because you're</p> <p>10 operating this in an almost vacuum</p> <p>11 atmosphere. So you don't have the oxygen</p> <p>12 to support it, even though cathode</p> <p>13 materials would have their own oxygen</p> <p>14 supply.</p> <p>15 Q Could it cause explosion?</p> <p>16 MR. SCHENKER: Objection,</p> <p>17 form, incomplete hypothetical.</p> <p>18 A It's an open system. Even</p> <p>19 though -- the chamber where this is</p> <p>20 occurring is somewhat closed. You don't</p> <p>21 have the concentration of materials that</p> <p>22 you would have and proximity of materials</p> <p>23 that you would have in a battery cell</p> <p>24 itself. So I don't think you would have</p> <p>25 an explosive situation at all.</p> | <p style="text-align: right;">Page 33</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form, mischaracterizes testimony.</p> <p>3 A The only reason that there</p> <p>4 would be still active battery material</p> <p>5 was that there was incomplete drying. It</p> <p>6 was wet. And it had electrolyte still</p> <p>7 there. If there is enough of electrolyte</p> <p>8 to react, you could have -- I cannot see</p> <p>9 a thermal runaway with this particular</p> <p>10 matter. But I could see some reaction</p> <p>11 done that might have some corrosive</p> <p>12 materials released. I would have to look</p> <p>13 at the full chemistry of it.</p> <p>14 Generally, even if the</p> <p>15 material is active because there's some</p> <p>16 wet material, there's not enough to</p> <p>17 support an electrochemical reaction that</p> <p>18 would go beyond a few seconds. It might</p> <p>19 be this particle reacted, discharged</p> <p>20 fully, you know, the rest of -- its</p> <p>21 cobalt oxide, lithium cobalt oxide.</p> <p>22 But I think when a wet</p> <p>23 material reaches that stage, that would</p> <p>24 certainly be of concern to me because</p> <p>25 that material might be corrosive and</p> |

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| <p style="text-align: right;">Page 34</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 affect the classifier's operation later.</p> <p>3 But you have discharged the battery.</p> <p>4 Then you've crushed and comminuted the</p> <p>5 materials. And you have put them through</p> <p>6 a pre-dryer. There's really going to</p> <p>7 be -- under normal operation, there</p> <p>8 should be no electrolyte there to support</p> <p>9 a reaction.</p> <p>10 Q So your testimony is that it</p> <p>11 would be concerning, but not dangerous?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form, mischaracterizes testimony.</p> <p>14 A I have the word dangerous in</p> <p>15 there. I've been around batteries long</p> <p>16 enough that whenever a condition is</p> <p>17 outside of normal, you have to treat it</p> <p>18 with a certain amount of caution and</p> <p>19 consider anything to be dangerous.</p> <p>20 Q Are active battery fragments</p> <p>21 dangerous alone?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form, incomplete hypothetical, calls</p> <p>24 for a legal conclusion.</p> <p>25 A In large quantities, in a</p>                                                                                                    | <p style="text-align: right;">Page 36</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 the electrochemical potential between</p> <p>3 cathode and anode particles now is very</p> <p>4 low because it's now discharged battery</p> <p>5 materials.</p> <p>6 Q You testified that when the</p> <p>7 battery fragments enter the pre-dryer,</p> <p>8 they're wet, and they're in contact with</p> <p>9 each other, and there can be some heating</p> <p>10 because of the electrochemical reactions</p> <p>11 going on.</p> <p>12 Can you tell me about the</p> <p>13 types of electrochemical reactions that</p> <p>14 could go on?</p> <p>15 MR. SCHENKER: Objection,</p> <p>16 form.</p> <p>17 A Long-winded here a little</p> <p>18 bit. You have the battery in your phone,</p> <p>19 your laptop. When the voltage -- when</p> <p>20 you need to recharge your battery, it's</p> <p>21 not down to zero volts. It's down to</p> <p>22 about three volts or two and a half,</p> <p>23 depending upon the manufacturer. And it</p> <p>24 can't support enough current to operate</p> <p>25 your device.</p>                                                                                                                                  |
| <p style="text-align: right;">Page 35</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 large mass, there are going to be cathode</p> <p>3 materials in contact with anode materials</p> <p>4 and electrolyte. When things are</p> <p>5 entering the pre-dryer, they can be in</p> <p>6 contact with each other. And that is</p> <p>7 operated to quickly dry the material out</p> <p>8 and thus have no electrolytes, so that</p> <p>9 you can't have an electrochemical</p> <p>10 reaction.</p> <p>11 But when they first enter</p> <p>12 the pre-dryer, they're wet, and they're</p> <p>13 in contact with each other. And there</p> <p>14 can be some heating because of some</p> <p>15 electrochemical reactions going on but</p> <p>16 not to the extent that you could cause a</p> <p>17 thermal runaway reaction or anything like</p> <p>18 that because again, as stated already,</p> <p>19 the batteries have been discharged which</p> <p>20 delithiates the cobalt oxide, the lithium</p> <p>21 cobalt oxide. The batteries have then</p> <p>22 been crushed. And even though crushed</p> <p>23 cathode particles are in contact with</p> <p>24 graphite, they're not going to be very</p> <p>25 reactive because a lot of the reaction,</p> | <p style="text-align: right;">Page 37</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 So you recharge. If you are</p> <p>3 allowing these materials to be in contact</p> <p>4 with each other, you don't have that</p> <p>5 electronic protection. So the anode and</p> <p>6 cathode, while touching each other, even</p> <p>7 in the presence of some wet electrolyte</p> <p>8 before they are dried, will just</p> <p>9 discharge. The lithium will go where it</p> <p>10 electrochemically is convenient to go.</p> <p>11 It will just basically reach a value</p> <p>12 where you do go down to that, close to</p> <p>13 zero volts, between this particle and</p> <p>14 this particle and their wetness. You</p> <p>15 will have motion of electrons and</p> <p>16 lithium-ions going back and forth to the</p> <p>17 point where you have discharged this to a</p> <p>18 completely zero state.</p> <p>19 So when you have basically</p> <p>20 disarranged the battery and the</p> <p>21 materials, it's different than</p> <p>22 discharging the battery in your devices</p> <p>23 because that's electronically controlled.</p> <p>24 This is just chemically controlled. The</p> <p>25 materials are in contact with each other.</p> |

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| <p style="text-align: right;">Page 38</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 And they're already in a discharged state</p> <p>3 because they've been electronically</p> <p>4 discharged and then crushed and then</p> <p>5 dried. Even if you haven't dried them</p> <p>6 yet, they're already in an</p> <p>7 electrochemically discharged state from</p> <p>8 getting them prepared for crushing.</p> <p>9 So a person of ordinary</p> <p>10 skill would understand that they're a lot</p> <p>11 safer now, that they're no longer</p> <p>12 contained inside of the battery pouch or</p> <p>13 can and, therefore, don't represent a</p> <p>14 danger. And certainly, they don't</p> <p>15 represent a danger of explosion because</p> <p>16 explosion in a lithium-ion battery often</p> <p>17 is accompanied by a lot of pressure, a</p> <p>18 lot of gas being generated. And if</p> <p>19 there's gas being generated here, you're</p> <p>20 in this pre-dryer, which is taking -- you</p> <p>21 know, operating at a reduced pressure and</p> <p>22 taking these gases away anyway. So</p> <p>23 you're not creating an explosive</p> <p>24 environment.</p> <p>25 Q So wet comminuted material</p> | <p style="text-align: right;">Page 40</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 a corrosive buildup or a pressure</p> <p>3 buildup?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form.</p> <p>6 A A pressure buildup in the</p> <p>7 extreme could burst the chamber. A</p> <p>8 pressure buildup that's smaller could</p> <p>9 affect your seals or your ability to</p> <p>10 control movement to the next chamber for</p> <p>11 the next process. But the corrosion in</p> <p>12 the pre-dryer, you've been generating and</p> <p>13 the preprocessing, you've been generating</p> <p>14 some HF from the decomposition of the</p> <p>15 LiPF6 salt in the battery which is</p> <p>16 ubiquitous in lithium-ion batteries. And</p> <p>17 it has been for the 45 years of its</p> <p>18 existence.</p> <p>19 The LiPF6 decomposed will</p> <p>20 form PF5, and it'll form LIF. And when</p> <p>21 hydrolyzed with any moisture, it will</p> <p>22 form HF. Hydrogen fluoride is extremely</p> <p>23 corrosive and toxic. And it will attack</p> <p>24 just about any metal and any plastic. So</p> <p>25 you want to keep its generation to a</p>                                                            |
| <p style="text-align: right;">Page 39</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 is safe, as long as the battery has been</p> <p>3 discharged properly; is that right?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form, incomplete hypothetical, lacks</p> <p>6 foundation.</p> <p>7 A Much safer because the</p> <p>8 battery has been discharged.</p> <p>9 Q But not completely safe;</p> <p>10 right?</p> <p>11 MR. SCHENKER: Objection,</p> <p>12 form, vague.</p> <p>13 A Any chemical processing</p> <p>14 system, you have to assume that, you</p> <p>15 know, you're just not doing this out on</p> <p>16 the table, you're doing this in these</p> <p>17 closed environments because you need to</p> <p>18 contain the chemical reactions. And any</p> <p>19 chemical reaction that you're trying to</p> <p>20 contain needs that containment because</p> <p>21 there's always the potential for a</p> <p>22 pressure buildup or corrosive buildup</p> <p>23 that you're trying to avoid happening in</p> <p>24 your system.</p> <p>25 Q What can happen if you have</p>                                                                                                                              | <p style="text-align: right;">Page 41</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 minimum. And this is why you have</p> <p>3 certain conditions of the pre-dryer,</p> <p>4 staying down below 80 degrees C, for</p> <p>5 example, where you will not generate much</p> <p>6 HF. The HF, it will cause some wear and</p> <p>7 tear on your materials, on your chamber,</p> <p>8 on your seals, but such small amounts.</p> <p>9 And in order to neutralize HF that's</p> <p>10 generated, part of the process is using a</p> <p>11 hydroxide or a carbonate, like lithium</p> <p>12 carbonate, calcium carbonate, calcium</p> <p>13 oxide to sequester the HF and render it</p> <p>14 harmless.</p> <p>15 So as an operator of the</p> <p>16 system, you have to be aware that there</p> <p>17 are dangers. You have to worry about</p> <p>18 things where you should be -- maybe</p> <p>19 dangerous was too strong a word. But you</p> <p>20 certainly have to be very aware and have</p> <p>21 caution that you're working with</p> <p>22 materials that don't necessarily like to</p> <p>23 be -- that will age your equipment and</p> <p>24 possibly harm the humans that are</p> <p>25 operating it.</p> |

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| <p style="text-align: right;">Page 42</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q If dangerous was too strong</p> <p>3 a word in your declaration, are there any</p> <p>4 other words that you think might be too</p> <p>5 strong of words in this declaration?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, mischaracterizes his testimony.</p> <p>8 A Well, you're talking about</p> <p>9 my whole declaration.</p> <p>10 Q Yes.</p> <p>11 A If you want to point some</p> <p>12 out that you have questions about, I'm</p> <p>13 still comfortable with the wording that</p> <p>14 I've put in this declaration.</p> <p>15 Q Aside from dangerous,</p> <p>16 obviously.</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form.</p> <p>19 A Aside from dangerous in this</p> <p>20 context.</p> <p>21 Q You also opine in your</p> <p>22 declaration that if wet battery fragments</p> <p>23 entered the separators and classifiers,</p> <p>24 it would result in clumping. Do you</p> <p>25 remember that?</p> | <p style="text-align: right;">Page 44</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 declaration. That's my answer.</p> <p>3 Q Do you have an opinion as to</p> <p>4 whether wet battery fragments entering</p> <p>5 the separators and classifiers that</p> <p>6 you've identified would result in</p> <p>7 clumping?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form.</p> <p>10 A May or may not. But I do</p> <p>11 say that damp material tends to clump</p> <p>12 together due to surface tension imparted</p> <p>13 by Freer, absorbed organic solvents from</p> <p>14 the battery electrolyte. And it makes it</p> <p>15 difficult for the particles to separate</p> <p>16 properly. So, yes, I say that the</p> <p>17 materials -- damp materials have a</p> <p>18 tendency, not an absolute, but a tendency</p> <p>19 to clump together.</p> <p>20 Q What is clumping?</p> <p>21 A You have individual</p> <p>22 particles. If they start to stick</p> <p>23 together and make larger conglomerates, I</p> <p>24 would classify that as clumping. So</p> <p>25 instead of seeing discrete particles,</p>      |
| <p style="text-align: right;">Page 43</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form.</p> <p>4 A I do.</p> <p>5 Q And your opinion is that</p> <p>6 this clumping would make the separators</p> <p>7 and classifiers not work properly; right?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form. Where in the declaration are</p> <p>10 you?</p> <p>11 MR. WALLER: I'm asking a</p> <p>12 question right now.</p> <p>13 A We're looking at</p> <p>14 paragraph 17?</p> <p>15 Q Well, I'm asking for what</p> <p>16 your opinion is. I'm asking you what</p> <p>17 your opinion is.</p> <p>18 A I'm going by any</p> <p>19 declaration. My opinions are in my</p> <p>20 declaration. So where are we in my</p> <p>21 declaration?</p> <p>22 Q I would like you to answer</p> <p>23 the question that I asked. I'm happy to</p> <p>24 re-ask it if you'd like.</p> <p>25 A My opinions are in my</p>                                                                               | <p style="text-align: right;">Page 45</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 you're now seeing a collective of</p> <p>3 particles that are sticking together.</p> <p>4 Q How does clumping of wet</p> <p>5 battery fragments occur?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form.</p> <p>8 A The solvents that are</p> <p>9 constituting the wetness, these are polar</p> <p>10 solvents, meaning that part of the</p> <p>11 molecule is electronegative, part of it</p> <p>12 is electropositive. Simplest case of</p> <p>13 that is not in the electrolyte, but is</p> <p>14 water. The oxygen of water is</p> <p>15 electronegative. The two hydrogens are</p> <p>16 electropositive.</p> <p>17 So when you're dissolving</p> <p>18 something in water, the positive ions are</p> <p>19 kind of attracted to and held on to by</p> <p>20 the water with the head of the oxygen</p> <p>21 sticking toward that ion.</p> <p>22 In a lithium-ion</p> <p>23 electrolyte, the solvents are also polar.</p> <p>24 And they are not as reactive as water</p> <p>25 would be, but they're designed that way,</p> |

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| <p style="text-align: right;">Page 46</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 the two, solvate the lithium. When you</p> <p>3 dissolve the salt, the PF6 goes its way.</p> <p>4 And the lithium is solvated and held on</p> <p>5 to by the solvent molecules. And this is</p> <p>6 how the process with solvation is</p> <p>7 working.</p> <p>8 Now, when you have a lot of</p> <p>9 material, a lot of this polar solvent</p> <p>10 present, you would be taking materials,</p> <p>11 not necessarily just ions, but it would</p> <p>12 stick to materials that have any polarity</p> <p>13 to them and then hold on to them</p> <p>14 together. And then they could start to</p> <p>15 accumulate, conglomerate and make clumps.</p> <p>16 Q How does this clumping</p> <p>17 impact the efficiency of the zig-zag</p> <p>18 classifier?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form.</p> <p>21 A If clumps are -- you know,</p> <p>22 the classifier is intended for the</p> <p>23 movement of dry particles. If you now</p> <p>24 have clumping, depending upon your -- the</p> <p>25 dimensions of your classifier for the</p> | <p style="text-align: right;">Page 48</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form.</p> <p>4 A Some of them. But these</p> <p>5 so-called colligative properties of polar</p> <p>6 molecules, attracting other materials and</p> <p>7 then holding on to them, you're not</p> <p>8 having a solvent molecule touching one</p> <p>9 thing. You're having a lot of solvent</p> <p>10 molecules perhaps touching a number of</p> <p>11 things. And they would clump together.</p> <p>12 They could get broken up if they're</p> <p>13 shaking off the shake table if the</p> <p>14 zig-zag was high-frequency enough. But</p> <p>15 again, the zig-zag is designed for</p> <p>16 separating dry particles. It's not</p> <p>17 designed for breaking up clumps. It will</p> <p>18 do that to some extent. But clumps will</p> <p>19 still collect and clog the classifier.</p> <p>20 Q Zig-zag classifiers are used</p> <p>21 in other industries; correct?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A I believe that's correct.</p> <p>25 Q Are you aware of any zig-zag</p> |
| <p style="text-align: right;">Page 47</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 material passing through and being</p> <p>3 separated, the classifier -- if the</p> <p>4 clumps are big, it may not operate at</p> <p>5 all. If they're -- if the clumps are</p> <p>6 small, it may let them pass through.</p> <p>7 But the design is relying on</p> <p>8 dry particles going through there, not</p> <p>9 clumped or wet particles going through,</p> <p>10 because that would -- if enough clumping</p> <p>11 was taking place or enough clumped</p> <p>12 particles of different sizes were moving,</p> <p>13 you could clog up the classifier and</p> <p>14 then, thus, the classifier would stop</p> <p>15 working.</p> <p>16 Q A zig-zag classifier</p> <p>17 operates by moving material back and</p> <p>18 forth; correct?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form.</p> <p>21 A I almost call it a shake</p> <p>22 table, yes.</p> <p>23 Q Wouldn't this shaking</p> <p>24 dislodge the clumps that you're talking</p> <p>25 about, break them up?</p>                                                                     | <p style="text-align: right;">Page 49</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 classifiers that operate under water?</p> <p>3 MR. SCHENKER: Objection,</p> <p>4 form, beyond the scope of the</p> <p>5 deposition.</p> <p>6 A That is beyond the scope of</p> <p>7 the deposition. So the answer to your</p> <p>8 question is, no, I'm not aware. I'm</p> <p>9 aware that they're used for, you know,</p> <p>10 sizing oranges, for example, that have</p> <p>11 been taken off the line, and you want to</p> <p>12 sell them in certain packages or certain</p> <p>13 size oranges.</p> <p>14 Q Are oranges completely dry?</p> <p>15 MR. SCHENKER: Objection,</p> <p>16 form.</p> <p>17 A They may have moisture on</p> <p>18 them. But an orange is macroscopic</p> <p>19 instead of microscopic. So any of these</p> <p>20 sticky properties that you have, due to a</p> <p>21 solvent or in the case of oranges,</p> <p>22 moisture, are overwhelmed by the size and</p> <p>23 weight of the orange.</p> <p>24 Q How would clumping impact</p> <p>25 the efficiency of the eddy current</p>                                 |

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| <p style="text-align: right;">Page 50</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 separator?<br/>3 A Maybe not so much as it<br/>4 would with the -- I think the biggest<br/>5 effect would be on the zig-zag. Eddy<br/>6 currents is going to produce a magnetic<br/>7 field, an AC magnetic field that will<br/>8 attract non-ferrous materials like the<br/>9 copper and the aluminum that are the<br/>10 support materials for the anode and<br/>11 cathode and bring those out into where<br/>12 they've been collected separately from<br/>13 other materials.<br/>14 In the zig-zag, the only<br/>15 interparticle interactions -- you have<br/>16 the interparticle interactions and the<br/>17 solvent polarity, as I mentioned, causing<br/>18 the colligative properties to cause<br/>19 clumping to form. But that's just a<br/>20 shake table. And that's mechanical.<br/>21 And with the eddy current<br/>22 system, you have a magnetic field that's<br/>23 being generated, an AC magnetic field<br/>24 that will basically shake things and then<br/>25 are tracked, the copper and aluminum. If</p> | <p style="text-align: right;">Page 52</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 the -- not clog. It wouldn't clog the<br/>3 eddy current separator. But it would<br/>4 probably affect its efficiency.<br/>5 Q How would clumping impact<br/>6 the efficiency of the magnetic separator?<br/>7 MR. SCHENKER: Objection,<br/>8 form, calls for a narrative.<br/>9 A In a similar way. Some of<br/>10 these materials are going to be<br/>11 intrinsically magnetic; for example, the<br/>12 oxides of cobalt, and you could separate<br/>13 out; you know, one of the expensive<br/>14 components of the battery is cobalt.<br/>15 So there is certainly<br/>16 motivation to collect and recycle and<br/>17 recover the cobalt. That's also true for<br/>18 other lithium-ion battery cathodes where<br/>19 they use -- you will see cathodes made of<br/>20 cobalt oxide, some with nickel cobalt and<br/>21 aluminum, nickel cobalt and manganese.<br/>22 And nickel -- battery-grade nickel is<br/>23 quite expensive. So recovering the<br/>24 nickel is also -- these metal oxides<br/>25 are -- have a magnetic -- intrinsically</p> |
| <p style="text-align: right;">Page 51</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 the particles are wet, it will still<br/>3 work, even if the materials are clumped.<br/>4 It just may not be quite as efficient.<br/>5 Q Why wouldn't it be quite as<br/>6 efficient?<br/>7 MR. SCHENKER: Objection,<br/>8 form --<br/>9 A Because it still --<br/>10 MR. SCHENKER: Calls for a<br/>11 narrative --<br/>12 THE WITNESS: Answer?<br/>13 MR. SCHENKER: You can<br/>14 answer.<br/>15 A It still would have to --<br/>16 you know, it's going to attract the<br/>17 copper and aluminum. But it may -- they<br/>18 may be clumped together with some<br/>19 graphite that it doesn't want or some<br/>20 other materials that it doesn't want.<br/>21 So it may not be a perfect<br/>22 separation. And you'll have some<br/>23 detritus from the other parts of the cell<br/>24 coming with it. So wet material would<br/>25 just -- causing clumps would just affect</p>                                                                                                                                             | <p style="text-align: right;">Page 53</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 magnetic property that a static magnet<br/>3 would be able to grab on to.<br/>4 So the eddy current magnetic<br/>5 field is attracting the non-ferrous<br/>6 materials. But the ferrous intrinsically<br/>7 magnetic materials, such as the metal<br/>8 oxides, would be done with the magnetic<br/>9 separator. And again, if you had<br/>10 clumping, some other materials that you<br/>11 didn't want might be coming through that<br/>12 process as well.<br/>13 Q Am I understanding correctly<br/>14 that clumping occurs due to electrolytes<br/>15 at the surface of the battery fragments?<br/>16 MR. SCHENKER: Objection,<br/>17 form.<br/>18 A Define what you mean by at<br/>19 the surface.<br/>20 Q There are electrolytes, at<br/>21 least on the outside of the battery<br/>22 fragment, in such a way that when you<br/>23 have two battery fragments, they stick<br/>24 together due to the electrolytes.<br/>25 MR. SCHENKER: Objection,</p>                                                                                            |

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| <p style="text-align: right;">Page 54</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form, vague.</p> <p>3 A Yeah. It's vague. There is</p> <p>4 a process, you know, you're going to</p> <p>5 have -- these materials are also porous.</p> <p>6 And you're going to have some solvent</p> <p>7 molecules inside the pores of a cathode</p> <p>8 or anode. They're purposely designed to</p> <p>9 be porous because you need electrolytes</p> <p>10 to get everywhere. It's like having a</p> <p>11 sponge or a Thomas English muffin. You</p> <p>12 want to get the electrolyte to get into</p> <p>13 every nook and cranny.</p> <p>14 You like that analogy?</p> <p>15 Q I do.</p> <p>16 A The electrolyte has to get</p> <p>17 wherever so it could do its work. It is</p> <p>18 in pores. It's also -- such as the</p> <p>19 surface of the electrode, the material is</p> <p>20 defined. Solvent molecules will adsorb</p> <p>21 on to the surface.</p> <p>22 Now, an adsorb material is</p> <p>23 kind of like stuck there from this</p> <p>24 polarity issue I mentioned. A polar</p> <p>25 solvent, it will stick. It's not a</p>             | <p style="text-align: right;">Page 56</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A No. I'm done here. I'll</p> <p>3 wait for your question.</p> <p>4 Q Okay.</p> <p>5 Your opinion is that</p> <p>6 clumping would not occur if the battery</p> <p>7 fragments were fully dry; correct?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form, mischaracterizes the</p> <p>10 declaration.</p> <p>11 A If they were fully dry,</p> <p>12 clumping would be either non-existent or</p> <p>13 minimal.</p> <p>14 Q Why is that the case?</p> <p>15 A When they're fully dry --</p> <p>16 and again, solvent molecules adsorbed on</p> <p>17 to a surface. That is still considered.</p> <p>18 If that's all that's there for solvent</p> <p>19 molecules, that's dry because that's not</p> <p>20 liquid. That's a solvent molecule</p> <p>21 attaching itself to the surface and</p> <p>22 saying, hey, I ain't going nowhere;</p> <p>23 right? And it's not getting together</p> <p>24 with other solvent molecules and saying,</p> <p>25 yeah, we're going to be liquid today.</p>                                                                                |
| <p style="text-align: right;">Page 55</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 free-flowing liquid. So you will have</p> <p>3 solvent molecules coming through, but</p> <p>4 they're not in liquid form. You may have</p> <p>5 a layer of a monolayer, maybe a bilayer,</p> <p>6 trilayer. You may have two or three</p> <p>7 solvent molecules and layers on a</p> <p>8 particle, not to mention what might be in</p> <p>9 the pores.</p> <p>10 But the drying process was</p> <p>11 supposed to get them out of the pores.</p> <p>12 But even if the drying process worked as</p> <p>13 it should, an adsorbed material is a</p> <p>14 different animal. It's not just going to</p> <p>15 come off without some additional help</p> <p>16 at -- perhaps either chemical help or</p> <p>17 other thermal processes which is why</p> <p>18 later they go through the decomposition.</p> <p>19 And the adsorbent materials will come</p> <p>20 off.</p> <p>21 Now, you wanted to know what</p> <p>22 happens with clumping and adsorbed</p> <p>23 solvents; is that what you're asking?</p> <p>24 Q No. But you can continue</p> <p>25 to --</p> | <p style="text-align: right;">Page 57</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 So it's dry. And if you do</p> <p>3 have liquids and a number of -- a lot</p> <p>4 of -- enough liquid is getting together</p> <p>5 that you're starting to have particles,</p> <p>6 this particle and this particle getting</p> <p>7 together, touching each other and</p> <p>8 sticking to each other, there's your</p> <p>9 clump. And where are you going to go</p> <p>10 with that clump? They stick together.</p> <p>11 So fully dried particles may</p> <p>12 come across with just your cathode</p> <p>13 particle or your anode particle, may have</p> <p>14 solvent adsorbed on to the surface,</p> <p>15 likely will have solvents adsorbed on to</p> <p>16 the surface. But it is still a dry</p> <p>17 particle because it is not liquid</p> <p>18 electrolyte there.</p> <p>19 Q I'm not quite sure that that</p> <p>20 answered my question which is, how is it</p> <p>21 a dried battery fragment would not clump?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A If you just had adsorbed</p> <p>25 organic solvents on a surface, you</p> |

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| <p style="text-align: right;">Page 58</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 probably wouldn't get much clumping. But</p> <p>3 if you had two or three layers of</p> <p>4 adsorbed material or even some extra</p> <p>5 liquid, if you had any liquid</p> <p>6 electrolyte, then the polar solvents</p> <p>7 would be attracted in part to the</p> <p>8 particle or maybe to each other or to</p> <p>9 another particle and then start to clump.</p> <p>10 So you could have -- if you</p> <p>11 had enough solvent molecules present, you</p> <p>12 could conceivably have some clumping.</p> <p>13 But I mean if I'm seeing two or three</p> <p>14 anode or cathode particles of comminuted</p> <p>15 material sticking together, I'm not as</p> <p>16 worried is if I see macroscopic amounts</p> <p>17 of them sticking together.</p> <p>18 And this I think goes into</p> <p>19 the design of the classifier and what you</p> <p>20 have for inputs to the classifier.</p> <p>21 Ideally, your inputs to the classifier</p> <p>22 are dried material that have gone through</p> <p>23 the pre-dryer and that they're properly</p> <p>24 dried. If dwell time in the heat wasn't</p> <p>25 long enough and you haven't properly</p> | <p style="text-align: right;">Page 60</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 record at 11:52, beginning Media Unit</p> <p>3 No. 2.</p> <p>4 Q Welcome back, Dr. van</p> <p>5 Schalkwijk. I did want to ask before we</p> <p>6 get started again.</p> <p>7 Did you have any</p> <p>8 conversations about the content of your</p> <p>9 testimony with counsel during the break?</p> <p>10 A We talked about in-laws and</p> <p>11 stuff like that.</p> <p>12 Q Did you discuss the content</p> <p>13 of your testimony with anybody during the</p> <p>14 break?</p> <p>15 A No.</p> <p>16 Q You state in your</p> <p>17 declaration that moisture and comminuted</p> <p>18 material can alter its conductivity,</p> <p>19 potentially affecting the efficacy of any</p> <p>20 current separation.</p> <p>21 Can you explain how that can</p> <p>22 be the case?</p> <p>23 MR. SCHENKER: Objection,</p> <p>24 form.</p> <p>25 A Depending upon the</p>                                                                                                                                                                                                   |
| <p style="text-align: right;">Page 59</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 dried them and they're coming through</p> <p>3 with some liquid, you're going to have</p> <p>4 big clumping issues. And you're going to</p> <p>5 have things sticking together.</p> <p>6 But in any case, you know,</p> <p>7 it's possible even in the best of --</p> <p>8 these are micron sized, tens of</p> <p>9 micron-sized particles. You're going to</p> <p>10 see a little bit of clumping, you know,</p> <p>11 two or three particles sticking together.</p> <p>12 But that's not enough, compared to the</p> <p>13 energies and frequencies of the zig-zag.</p> <p>14 So you would have to have clumps that are</p> <p>15 big enough, that they overwhelm the</p> <p>16 zig-zag classifier.</p> <p>17 MR. SCHENKER: Counsel,</p> <p>18 we've been going for about an hour</p> <p>19 now. Take a break?</p> <p>20 MR. WALLER: Sure.</p> <p>21 THE VIDEOGRAPHER: Off the</p> <p>22 record at 11:37, marking the end of</p> <p>23 Media Unit No. 1.</p> <p>24 (A short recess was taken.)</p> <p>25 THE VIDEOGRAPHER: On the</p>                                                                                                                    | <p style="text-align: right;">Page 61</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 implementation of the eddy current and</p> <p>3 the frequency that's used in generating</p> <p>4 that field, it will find itself attracted</p> <p>5 to polar materials, like the solvents.</p> <p>6 And if you have a lot of -- if you have</p> <p>7 wetness, either from water, which</p> <p>8 wouldn't survive very long, or these</p> <p>9 polar solvent molecules in any quantity,</p> <p>10 they would render the magnetic field, the</p> <p>11 eddy current a little bit less strong and</p> <p>12 then reduce the ability of the materials</p> <p>13 to be separated as well. You wouldn't</p> <p>14 even need the clumping if it was just wet</p> <p>15 with solvent molecules. It would affect</p> <p>16 the material.</p> <p>17 Q The conductivity of the</p> <p>18 material?</p> <p>19 MR. SCHENKER: Objection to</p> <p>20 form, vague.</p> <p>21 A If you've affected its</p> <p>22 conductivity, the eddy current is</p> <p>23 attracted to conductive materials. Are</p> <p>24 you aware of how like an eddy current</p> <p>25 works in other things?</p> |

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| <p style="text-align: right;">Page 62</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Well, I want to be careful</p> <p>3 in not answering your questions. You</p> <p>4 provided testimony on an eddy current</p> <p>5 separator earlier. So I've got that.</p> <p>6 A All right. We encounter the</p> <p>7 sensors every day in traffic. The little</p> <p>8 circle that you see under the pavement,</p> <p>9 sometimes you see with some drying of</p> <p>10 something round underneath, like maybe</p> <p>11 something's buried at the traffic light.</p> <p>12 That's a wire. And it's putting out eddy</p> <p>13 current. And if it just sees air, it</p> <p>14 knows that there's no cars there. If it</p> <p>15 sees conductive material, i.e., the metal</p> <p>16 of your car, it will send a signal that,</p> <p>17 yeah, someone's here waiting at the red</p> <p>18 light.</p> <p>19 MR. SCHENKER: Did someone</p> <p>20 new just join the Zoom?</p> <p>21 THE VIDEOGRAPHER: I don't</p> <p>22 think it's anybody new. Steven</p> <p>23 Carlson. I think he was here</p> <p>24 earlier.</p> <p>25 MR. SCHENKER: Mr. Carlson</p> | <p style="text-align: right;">Page 64</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 inactive materials."</p> <p>3 Do you remember writing</p> <p>4 that?</p> <p>5 A Where did I write that?</p> <p>6 Q Let me direct you to</p> <p>7 paragraph 14 of your declaration.</p> <p>8 A Yes.</p> <p>9 Q And by these mechanical</p> <p>10 separation techniques, I assume you're</p> <p>11 talking about zig-zag classifiers, eddy</p> <p>12 current separators and magnetic</p> <p>13 separators?</p> <p>14 A Yes.</p> <p>15 Q Hanisch describes these</p> <p>16 separators and classifiers as optional;</p> <p>17 correct?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 form.</p> <p>20 A Could you show me in Hanisch</p> <p>21 where it says that?</p> <p>22 Q Do you recall whether</p> <p>23 Hanisch says that the classifiers and</p> <p>24 separators are optional?</p> <p>25 A That --</p>                                                                                                                       |
| <p style="text-align: right;">Page 63</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 wasn't on the record.</p> <p>3 A So we're doing eddy currents</p> <p>4 a lot. They're also used to tell whether</p> <p>5 the aircraft landing gear is up or</p> <p>6 whether the doors are properly shut.</p> <p>7 Q How would drying of the cell</p> <p>8 fragments impact the conductivity of the</p> <p>9 fragments?</p> <p>10 MR. SCHENKER: Objection,</p> <p>11 vague.</p> <p>12 A It would take away one kind</p> <p>13 of conductivity. But still, the eddy</p> <p>14 current is trying to separate out</p> <p>15 electrically conductive materials, i.e.,</p> <p>16 the copper and the aluminum. But having</p> <p>17 a lot of solvent there and perhaps the</p> <p>18 solvent carrying electrolyte would affect</p> <p>19 the conductivity.</p> <p>20 Q You also state in your</p> <p>21 declaration that "These mechanical</p> <p>22 separation techniques have been integral</p> <p>23 to LIB recycling processes developed</p> <p>24 before 2015, offering efficient methods</p> <p>25 for processing dry, electrochemically</p>            | <p style="text-align: right;">Page 65</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection to</p> <p>3 form. He asked to see a document.</p> <p>4 A I want to see the document.</p> <p>5 Q Well, I want to establish</p> <p>6 first, do you remember or not whether</p> <p>7 Hanisch says that?</p> <p>8 A Hanisch said a lot of</p> <p>9 things. I'd like to see Hanisch. So</p> <p>10 please hand it over.</p> <p>11 Q I will hand it to you if you</p> <p>12 testify that -- well, I need an answer to</p> <p>13 the question.</p> <p>14 If you don't recall whether</p> <p>15 Hanisch says that the classifiers are</p> <p>16 optional or not, I can refresh your</p> <p>17 recollection; however, if you do</p> <p>18 remember, I would prefer that you answer</p> <p>19 the question.</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 form.</p> <p>22 A I would like to see the</p> <p>23 document because I don't specifically</p> <p>24 remember that.</p> <p>25 MR. SCHENKER: What's the</p> |

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| <p style="text-align: right;">Page 66</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 question?</p> <p>3 THE WITNESS: I said the</p> <p>4 past word.</p> <p>5 MR. WALLER: I'm showing a</p> <p>6 witness a document that's been</p> <p>7 previously been marked Exhibit 10004.</p> <p>8 MR. SCHENKER: That's 1004.</p> <p>9 MR. WALLER: Apologies.</p> <p>10 MR. SCHENKER: Just two</p> <p>11 zeros.</p> <p>12 Q And I would like to direct</p> <p>13 you to Column 6, lines 2 and 3.</p> <p>14 A Okay. It's optional. And</p> <p>15 the rest of line 3, it's particularly</p> <p>16 advantageous, only if the cathode of the</p> <p>17 galvanic cells is to be reused, as is the</p> <p>18 present case.</p> <p>19 Q So Hanisch describes these</p> <p>20 separators and classifiers that we've</p> <p>21 been talking about as optional; correct?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A Yes. Hanisch says they're</p> <p>25 optional but then qualifies it with that</p>                                                | <p style="text-align: right;">Page 68</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 mechanical separator?</p> <p>3 A Right.</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form, speculation.</p> <p>6 A That is possible.</p> <p>7 Q That's because they're</p> <p>8 optional; right?</p> <p>9 MR. SCHENKER: Objection,</p> <p>10 form.</p> <p>11 A Depends on what you're</p> <p>12 trying to recycle, as it says right here</p> <p>13 in the same paragraph.</p> <p>14 Q You also state in your</p> <p>15 declaration that Hanisch, in view of the</p> <p>16 knowledge of a POSITA, renders obvious,</p> <p>17 wherein the drying occurs at a maximum</p> <p>18 pressure of 300 hectopascals. You recall</p> <p>19 writing that?</p> <p>20 A Where are we?</p> <p>21 Q I want to get your testimony</p> <p>22 as to whether you remember having that</p> <p>23 opinion or not.</p> <p>24 MR. SCHENKER: Counsel, he</p> <p>25 asked you to direct him to his</p>                                                                                    |
| <p style="text-align: right;">Page 67</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 it's advantageous if only the cathode is</p> <p>3 to be reused.</p> <p>4 Q Would a POSITA then</p> <p>5 understand that these optional</p> <p>6 classifiers and separators need to be</p> <p>7 used in Hanisch's system?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form.</p> <p>10 A They're advantageous if only</p> <p>11 the cathode of the galvanic cells is to</p> <p>12 be reused. So if you are trying to</p> <p>13 recover cathode, you want to use them.</p> <p>14 Q But there are other</p> <p>15 instances where you wouldn't want to use</p> <p>16 them; right?</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form.</p> <p>19 A Depends on the battery</p> <p>20 chemistry that you're looking at. All</p> <p>21 lithium-ion batteries are not alike.</p> <p>22 Q So there would still be some</p> <p>23 configurations of Hanisch where you</p> <p>24 wouldn't want to use a zig-zag classifier</p> <p>25 or an eddy current separator or a</p> | <p style="text-align: right;">Page 69</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 declaration where you're reading</p> <p>3 from.</p> <p>4 A Where are you reading from?</p> <p>5 Q Do you remember having that</p> <p>6 opinion or not?</p> <p>7 A Where are you reading from?</p> <p>8 Q Could you please answer the</p> <p>9 question?</p> <p>10 MR. SCHENKER: Objection,</p> <p>11 form. The witness is asking you to</p> <p>12 direct him to where in his</p> <p>13 declaration you're reading from.</p> <p>14 A And I could take up time</p> <p>15 reading the whole thing again to get to</p> <p>16 that one place where you could just send</p> <p>17 me.</p> <p>18 Q Well, I want to get your</p> <p>19 testimony. I don't want you to read your</p> <p>20 declaration back to me. That's not the</p> <p>21 point of today's exercise.</p> <p>22 So I want to establish, do</p> <p>23 you remember having an opinion as to</p> <p>24 whether Hanisch, in view of the knowledge</p> <p>25 of a POSITA, renders obvious, wherein the</p> |

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| <p style="text-align: right;">Page 70</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 drying occurs at a maximum pressure of<br/>3 300 hectopascals?<br/>4 MR. SCHENKER: Objection,<br/>5 form.<br/>6 Q Do you have an opinion on<br/>7 that or not?<br/>8 MR. SCHENKER: Objection,<br/>9 form.<br/>10 A I might or might not have<br/>11 said that in here. But you're going to<br/>12 tell me. But I agree with that. And I'd<br/>13 like now for you to tell me where.<br/>14 Q Let me direct you to<br/>15 paragraph 19 in your declaration.<br/>16 A 19. I see it right there.<br/>17 Q Do you recall now whether<br/>18 you have an opinion regarding whether<br/>19 Hanisch, in view of the knowledge of a<br/>20 POSITA, renders obvious the 300<br/>21 hectopascal limitation of the patent at<br/>22 issue?<br/>23 MR. SCHENKER: Objection,<br/>24 form.<br/>25 A Yes. I agree that the goal</p>                                           | <p style="text-align: right;">Page 72</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 Q And your opinion is that a<br/>3 POSITA would understand from Hanisch that<br/>4 preserving the quality of the copper is a<br/>5 goal of the patent; right?<br/>6 MR. SCHENKER: Objection.<br/>7 A It is a goal of -- one of<br/>8 the goals of the recycling, is to recover<br/>9 those two metals.<br/>10 Q And it's this lithium cobalt<br/>11 oxide that's creating the oxygen in the<br/>12 decomposition step of Hanisch that's<br/>13 creating the oxidization of the copper;<br/>14 right?<br/>15 MR. SCHENKER: Objection,<br/>16 form.<br/>17 A Well, you're going to<br/>18 have -- over in paragraph 22, I describe<br/>19 the delithiated lithium cobalt oxide and<br/>20 the reactions where you would then form<br/>21 some oxygen. But you're going to have<br/>22 two sources of oxygen in the chamber.<br/>23 You're going to have this from the<br/>24 delithiated cobalt oxide. And you're<br/>25 going to have atmospheric oxygen that's</p>                                                                             |
| <p style="text-align: right;">Page 71</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 of going below that pressure or having<br/>3 that maximum pressure of 300 hPa is --<br/>4 there are reasons for it. And it's<br/>5 perhaps an arbitrary pressure. But it<br/>6 has its value because you're trying to<br/>7 minimize the reactivity of oxygen with<br/>8 copper and aluminum. And you're trying<br/>9 to recover copper and aluminum.<br/>10 Q And the oxidization<br/>11 essentially diminishes the quality of the<br/>12 copper; right?<br/>13 MR. SCHENKER: Objection,<br/>14 form.<br/>15 THE VIDEOGRAPHER: Belle<br/>16 Borovik.<br/>17 THE WITNESS: Yes. Avon<br/>18 ladies here. Are people going to be<br/>19 coming in and out of this?<br/>20 THE VIDEOGRAPHER: I can<br/>21 turn that out.<br/>22 A It will -- if you oxidize<br/>23 the surface of the copper and the<br/>24 aluminum, you somewhat reduce their<br/>25 value.</p> | <p style="text-align: right;">Page 73</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/>2 also in the chamber already.<br/>3 So you have two sources. I<br/>4 went through at least showing -- I think<br/>5 my calculations were incomplete. But I<br/>6 was showing -- at least from the<br/>7 atmospheric oxygen in paragraph 24, I was<br/>8 showing how much oxygen would be present<br/>9 at 300 hPa and that -- how much, if you<br/>10 had a very strong vacuum, very complete<br/>11 suction, as well as most machines could<br/>12 do, you would have much smaller oxygen<br/>13 content.<br/>14 But if you're constantly<br/>15 pulling that vacuum, even the oxygen that<br/>16 might be generated from the delithiated<br/>17 material is being sucked out anyway as<br/>18 part of getting to your 300 hPa.<br/>19 So the whole exercise of the<br/>20 300 hPa is to minimize oxygen in the<br/>21 chamber, so that you minimize oxidation<br/>22 of the copper and the aluminum. That's<br/>23 what this whole exercise was about.<br/>24 Q But theoretically, you could<br/>25 flush the oven with a relatively weak</p> |

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| <p style="text-align: right;">Page 74</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 vacuum; right?</p> <p>3 MR. SCHENKER: Objection,</p> <p>4 form, incomplete hypothetical, vague.</p> <p>5 A You could flush it with a</p> <p>6 vacuum of any form of suction, as long as</p> <p>7 you were continuing to move out the</p> <p>8 reactive material, the oxygen.</p> <p>9 Q And that would pull out the</p> <p>10 oxygen from the decomposition step?</p> <p>11 A It would remove oxygen from</p> <p>12 that process or minimize the oxygen from</p> <p>13 that process.</p> <p>14 Q Sure.</p> <p>15 Now, as I understand your</p> <p>16 opinion, essentially, what causes this --</p> <p>17 what is it? -- lithium cobalt oxide to</p> <p>18 release oxygen is that it's being</p> <p>19 subjected to heat in the oven; right?</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 form.</p> <p>22 A Well, you removed the</p> <p>23 lithium from the cobalt oxide, the</p> <p>24 lithium cobalt oxide. What you have</p> <p>25 behind is a small amount of lithium still</p>                                                                                                       | <p style="text-align: right;">Page 76</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 vague, incomplete hypothetical,</p> <p>4 outside the scope of his declaration.</p> <p>5 THE WITNESS: But answer it?</p> <p>6 But I should answer it?</p> <p>7 Q Yes. You could answer it.</p> <p>8 THE WITNESS: I'm asking</p> <p>9 him.</p> <p>10 MR. WALLER: You can answer</p> <p>11 it. He should answer it. And I</p> <p>12 would, actually, if you instruct him</p> <p>13 not to answer, I would like to get</p> <p>14 the basis for how it's outside the</p> <p>15 scope of his declaration.</p> <p>16 MR. SCHENKER: Well, he</p> <p>17 hasn't testified to in his</p> <p>18 declaration about anything relating</p> <p>19 to discharge.</p> <p>20 MR. WALLER: Yes, he has.</p> <p>21 MR. SCHENKER: But in any</p> <p>22 event, do you understand the</p> <p>23 question?</p> <p>24 THE WITNESS: I do.</p> <p>25 A You discharge the battery</p>                                                                                                                                                                                                                                                                                                  |
| <p style="text-align: right;">Page 75</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 in the structure.</p> <p>3 And as I describe further</p> <p>4 down in paragraph 22, it remains possible</p> <p>5 that a small portion of that species, in</p> <p>6 other words, lithium cobalt oxide, will</p> <p>7 remain in the comminuted materials being</p> <p>8 processed at high temperature.</p> <p>9 And then when decomposed,</p> <p>10 that material undergoes the reaction,</p> <p>11 releasing reactive oxygen that can</p> <p>12 contribute to the oxidation of copper.</p> <p>13 So you have this situation where without</p> <p>14 having the vacuum being pulled, you have</p> <p>15 oxygen coming from the lithium cobalt</p> <p>16 oxide, and you just have atmospheric</p> <p>17 oxygen that is already present at 300</p> <p>18 hPa.</p> <p>19 So what you're trying to do</p> <p>20 is continually suction the material, so</p> <p>21 that oxygen is being removed and no</p> <p>22 matter what its source, whether</p> <p>23 atmospheric or from the decomposition.</p> <p>24 Q Would you have this reaction</p> <p>25 if you properly discharged the battery?</p> | <p style="text-align: right;">Page 77</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 before you crush it and grind it. In</p> <p>3 discharging it, you've removed a lot of</p> <p>4 the lithium in the first place. And by</p> <p>5 doing that, you've made it -- but it</p> <p>6 doesn't remove everything. You're still</p> <p>7 going to have some lithium left behind.</p> <p>8 If you look at the formula</p> <p>9 of the first line in paragraph 22,</p> <p>10 delithiated <math>\text{Li}_x\text{CoO}_2</math> where X equals 0.49</p> <p>11 to 0.9, and those are kind of a couple of</p> <p>12 extremes of the process. But you could</p> <p>13 still have as much as 90 percent of your</p> <p>14 lithium still there and as little as like</p> <p>15 half of it still there. So it's still</p> <p>16 going to be appreciably full of lithium,</p> <p>17 even after discharging.</p> <p>18 Again, the discharging is</p> <p>19 never complete unless you will let it go</p> <p>20 for a long, long time. The process where</p> <p>21 your battery in your laptop or your phone</p> <p>22 gets down to two and a half, three volts,</p> <p>23 you've removed at least half of the</p> <p>24 lithium when you're down to, say, 0.49.</p> <p>25 If you -- nevermind.</p> |

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| <p style="text-align: right;">Page 78</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Is that the end of your</p> <p>3 answer, Dr. van Schalkwijk?</p> <p>4 A That's the end of my answer.</p> <p>5 Q You write in paragraph 22 of</p> <p>6 your declaration at the end, "This can be</p> <p>7 a non-trivial amount of oxygen when not</p> <p>8 completely controlled by discharging the</p> <p>9 batteries."</p> <p>10 You see that?</p> <p>11 A Yes.</p> <p>12 Q What do you mean by "when</p> <p>13 not completely controlled by discharging</p> <p>14 the batteries"?</p> <p>15 A If in the pre-crushing stage</p> <p>16 you didn't discharge the batteries well</p> <p>17 or you just threw batteries into the</p> <p>18 grinder, One, that would be dangerous.</p> <p>19 And, Two, you would not be -- you need to</p> <p>20 control the discharge of the batteries.</p> <p>21 You need to put them on something</p> <p>22 that's -- you don't have to. There are</p> <p>23 many ways to discharge a battery other</p> <p>24 than hitching it up to a circuit.</p> <p>25 But unless you control the</p> | <p style="text-align: right;">Page 80</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 easily be designed to maintain an</p> <p>3 eventually high vacuum.</p> <p>4 Q It takes a lot of energy to</p> <p>5 maintain that vacuum, though; correct?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, vague.</p> <p>8 A Depends on how you reach</p> <p>9 that vacuum and how big of a chamber you</p> <p>10 have left over for what you're doing with</p> <p>11 it.</p> <p>12 Q So I guess in general, is it</p> <p>13 more difficult to maintain a high vacuum</p> <p>14 in a continuous process system or a batch</p> <p>15 process system?</p> <p>16 MR. SCHENKER: Objection,</p> <p>17 vague.</p> <p>18 A The vacuum system could be</p> <p>19 used -- a singular design of a vacuum</p> <p>20 system can be used in either a continuous</p> <p>21 or a batch process.</p> <p>22 Q Is it easier to maintain the</p> <p>23 vacuum in one system versus the other?</p> <p>24 MR. SCHENKER: Objection,</p> <p>25 vague.</p> |
| <p style="text-align: right;">Page 79</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 discharging to make sure it gets down to</p> <p>3 a certain voltage, and they can measure</p> <p>4 the voltages of the battery before</p> <p>5 sending them to the grinder, but you need</p> <p>6 to understand that they have to have gone</p> <p>7 through this process before you grind</p> <p>8 them.</p> <p>9 Q But you can completely</p> <p>10 control this reaction by discharging the</p> <p>11 battery; right?</p> <p>12 A Actively discharging it.</p> <p>13 Q Actively discharging, yes.</p> <p>14 A Yes.</p> <p>15 Q Is it difficult to maintain</p> <p>16 a high vacuum in a continuous process</p> <p>17 system?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 form.</p> <p>20 A Difficult to maintain a high</p> <p>21 vacuum in a continuous process system?</p> <p>22 The valves and seals that you use are</p> <p>23 going to be different, depending upon the</p> <p>24 pressure ranges that you're operating in.</p> <p>25 But it's not difficult. A system can</p>                                   | <p style="text-align: right;">Page 81</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A Depends on your</p> <p>3 implementation of the valves and</p> <p>4 chambers.</p> <p>5 Q Hanisch teaches subjecting</p> <p>6 the decomposition of an oven to a vacuum</p> <p>7 or inert gas; right?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form.</p> <p>10 A I believe he says, yes,</p> <p>11 vacuum or inert gas.</p> <p>12 Q Which would be cheaper?</p> <p>13 Inert gas or maintaining a vacuum?</p> <p>14 MR. SCHENKER: Objection,</p> <p>15 form, outside the scope of his depo.</p> <p>16 You don't have to answer that.</p> <p>17 THE WITNESS: Okay.</p> <p>18 MR. WALLER: Well, hang on.</p> <p>19 Explain how it's outside the scope.</p> <p>20 MR. SCHENKER: He hasn't</p> <p>21 testified or given any type of direct</p> <p>22 testimony on the relative costs of</p> <p>23 one over the other or the costs</p> <p>24 altogether.</p> <p>25 Q So you don't have an opinion</p>                                   |

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| <p style="text-align: right;">Page 82</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 on whether one would be more</p> <p>3 cost-efficient versus the other?</p> <p>4 MR. SCHENKER: You don't</p> <p>5 have to answer that.</p> <p>6 A I didn't do a cost analysis</p> <p>7 of these.</p> <p>8 Q Is it also your opinion that</p> <p>9 a POSITA would have a reasonable</p> <p>10 likelihood of success implementing</p> <p>11 Hayashi's vacuum in Hanisch's system?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form, vague.</p> <p>14 A Vague. And did I opine on</p> <p>15 Hayashi's vacuum system here?</p> <p>16 Q I'm asking if you did or</p> <p>17 not.</p> <p>18 A I didn't make that</p> <p>19 comparison.</p> <p>20 Q Do you remember what Hayashi</p> <p>21 teaches for a vacuum?</p> <p>22 A Not off the top of my head.</p> <p>23 Q Would a POSITA be motivated</p> <p>24 to combine Hayashi with Hanisch?</p> <p>25 MR. SCHENKER: Objection,</p>                                         | <p style="text-align: right;">Page 84</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 taking the position that he doesn't</p> <p>3 have a position on this, on whether a</p> <p>4 POSITA would be motivated to combine</p> <p>5 Hayashi with Hanisch; is that the</p> <p>6 scope of the objection?</p> <p>7 MR. SCHENKER: It's very</p> <p>8 simple. If you're asking him</p> <p>9 questions about his first declaration</p> <p>10 and opinions that he had there and</p> <p>11 his opinions that he has in general,</p> <p>12 then I'm going to object as outside</p> <p>13 the scope of this deposition. Your</p> <p>14 already had the opportunity to depose</p> <p>15 him, and you have deposed him on his</p> <p>16 first declaration and his opinions</p> <p>17 with respect to that first</p> <p>18 declaration.</p> <p>19 If you're asking him about</p> <p>20 his opinions with respect to this</p> <p>21 declaration, then that's within the</p> <p>22 scope of this deposition. And you're</p> <p>23 welcome to direct him to where in the</p> <p>24 declaration you're asking him about.</p> <p>25 But asking him his opinions generally</p> |
| <p style="text-align: right;">Page 83</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form.</p> <p>3 A To what end?</p> <p>4 Q That's what I'm asking you.</p> <p>5 Would a POSITA be motivated</p> <p>6 to combine Hayashi's vacuum with</p> <p>7 Hanisch's system?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form. And, counsel, are you asking</p> <p>10 him something that's in this</p> <p>11 declaration or are you asking him his</p> <p>12 opinion generally?</p> <p>13 MR. WALLER: I would like</p> <p>14 him to see if he could answer the</p> <p>15 question.</p> <p>16 MR. SCHENKER: I'm going to</p> <p>17 object to this as outside of scope,</p> <p>18 unless you could point him to the</p> <p>19 declaration and the direct testimony</p> <p>20 that's at issue here that you're</p> <p>21 questioning him on. And I'm going to</p> <p>22 instruct the witness not to answer</p> <p>23 without this being tied to his</p> <p>24 declaration here.</p> <p>25 MR. WALLER: So are you</p> | <p style="text-align: right;">Page 85</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 about Hanisch and Hayashi are not</p> <p>3 fair game, considering that you've</p> <p>4 already deposed him on that.</p> <p>5 MR. WALLER: Okay. Let's</p> <p>6 move on.</p> <p>7 Q You state in your</p> <p>8 declaration at paragraph 32, "Even if one</p> <p>9 assumed the single rotary airlock would</p> <p>10 be difficult to use across the pressure</p> <p>11 differences needed to maintain less than</p> <p>12 300 hectopascals in a drying changer, one</p> <p>13 possible approach would be to use a</p> <p>14 series of such airlocks."</p> <p>15 You see where I am?</p> <p>16 A I see that.</p> <p>17 Q Are you aware of any</p> <p>18 continuous processes that utilize such a</p> <p>19 system of airlocks?</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 form. You could answer.</p> <p>22 A I've seen it in the</p> <p>23 manufacture, not the recycling. But I've</p> <p>24 seen it in the manufacture of some of the</p> <p>25 cathode materials for lithium-ion</p>                                                                             |

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| <p style="text-align: right;">Page 86</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 batteries where things are done in</p> <p>3 nitrogen atmospheres and are done at</p> <p>4 different pressures of nitrogen. And</p> <p>5 they use a number of seals. All seals</p> <p>6 are not alike. Some are very coarse and</p> <p>7 operate only within a narrow pressure</p> <p>8 range.</p> <p>9 Q But you've never seen it</p> <p>10 done in the recycling process or for a</p> <p>11 continuous process?</p> <p>12 A I've seen it --</p> <p>13 MR. SCHENKER: Objection to</p> <p>14 form.</p> <p>15 A -- a continuous process for</p> <p>16 the manufacturing of the materials, but</p> <p>17 not in the recycling of the materials.</p> <p>18 But this is a chemical engineering</p> <p>19 exercise. And doing it with a series of</p> <p>20 airlocks is totally reasonable.</p> <p>21 And a POSITA would be -- you</p> <p>22 know, if the POSITA had any -- depending</p> <p>23 upon how he had defined POSITA -- and I</p> <p>24 think we gave that POSITA a fair amount</p> <p>25 of knowledge and experience -- they would</p>  | <p style="text-align: right;">Page 88</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 any examples where they have?</p> <p>3 MR. SCHENKER: Objection,</p> <p>4 form, mischaracterizes the earlier</p> <p>5 testimony, mischaracterizes the law.</p> <p>6 A A POSITA in this arena is</p> <p>7 going to have -- a POSITA who's making a</p> <p>8 battery and disassembling a battery,</p> <p>9 disassembling a battery is going to have</p> <p>10 a similar skill set. And I have mostly</p> <p>11 lived my career in the building of</p> <p>12 batteries. And I see this kind of</p> <p>13 multi-stage valve used a lot and not just</p> <p>14 in batteries, but in other industries</p> <p>15 where you're trying to pull a vacuum,</p> <p>16 semiconductor industries done in high</p> <p>17 vacuum. But you don't achieve it all at</p> <p>18 once. You achieve it over some stages.</p> <p>19 And they use multiple valve systems.</p> <p>20 So a POSITA would have drawn</p> <p>21 upon knowledge in chemical engineering to</p> <p>22 say, gee, I can do that and do this.</p> <p>23 Just because I haven't gone and seen a</p> <p>24 multi-valve system, doesn't mean it</p> <p>25 doesn't exist. If you're going to ask me</p> |
| <p style="text-align: right;">Page 87</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 understand that you could use a series of</p> <p>3 airlocks that had different pressure</p> <p>4 range capabilities to do this which</p> <p>5 Dantam doesn't explain why this would</p> <p>6 have -- he says it was beyond the skill</p> <p>7 of a POSITA. And it's not. This is</p> <p>8 something where this is done in a number</p> <p>9 of different manufacturing environments.</p> <p>10 Q Why hasn't a POSITA done</p> <p>11 this in the recycling process then?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form.</p> <p>14 A How do you know they</p> <p>15 haven't?</p> <p>16 MR. SCHENKER: Speculation.</p> <p>17 Q Because you just testified.</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 mischaracterizes his prior testimony.</p> <p>20 Q You testified that you're</p> <p>21 not aware of any other recycling process</p> <p>22 that uses a multiple series of airlocks.</p> <p>23 So I'm trying to understand,</p> <p>24 how can you know it would be obvious of a</p> <p>25 POSITA to do this if you're not aware of</p> | <p style="text-align: right;">Page 89</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 about this and where is it and why isn't</p> <p>3 it there --</p> <p>4 Q Well, I would like you to</p> <p>5 answer the question that I have pending,</p> <p>6 not the ones that you may think that I</p> <p>7 have pending.</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form. Is there a question pending</p> <p>10 now?</p> <p>11 Q Are you still answering my</p> <p>12 previous question, Dr. van Schalkwijk?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form.</p> <p>15 A I haven't seen it done. But</p> <p>16 that doesn't mean it hasn't been done.</p> <p>17 Q Are you familiar with the</p> <p>18 Medior reference?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 outside the scope of the deposition.</p> <p>21 MR. WALLER: Why is it</p> <p>22 outside the scope?</p> <p>23 MR. SCHENKER: Because he</p> <p>24 doesn't testify to any direct</p> <p>25 testimony in his declaration with</p>                                                                                                                                                                                                                                          |

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| <p style="text-align: right;">Page 90</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 respect to the Medior reference.</p> <p>3 Q Do you recall having looked</p> <p>4 at Medior in the preparation of this</p> <p>5 declaration?</p> <p>6 A No.</p> <p>7 Q Why didn't you consider</p> <p>8 Medior for this declaration?</p> <p>9 MR. SCHENKER: Objection.</p> <p>10 A Medior was not part of what</p> <p>11 I was considering for this declaration.</p> <p>12 Q Why not?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form.</p> <p>15 A I had enough other pieces to</p> <p>16 put together for this declaration. I</p> <p>17 didn't even have to consider Medior. So</p> <p>18 Medior is not on the table for me.</p> <p>19 Q And one of the references</p> <p>20 that you've discussed is Hayashi.</p> <p>21 A Yes.</p> <p>22 Q Between the two of them,</p> <p>23 would a POSITA have combined Hayashi and</p> <p>24 Hanisch or Medior and Hanisch?</p> <p>25 MR. SCHENKER: Objection,</p> | <p style="text-align: right;">Page 92</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Do you know what that is?</p> <p>3 MR. SCHENKER: Objection,</p> <p>4 form.</p> <p>5 A 28 I believe is the</p> <p>6 pre-dryer, and E4 is the conveyor.</p> <p>7 Q And do you understand the</p> <p>8 conveyor to be inside the pre-dryer?</p> <p>9 A That is how it is depicted</p> <p>10 here. So that's how I would interpret</p> <p>11 it.</p> <p>12 Q Would this indicate to you</p> <p>13 that the pre-dryer is a belt dryer?</p> <p>14 MR. SCHENKER: Objection,</p> <p>15 form.</p> <p>16 A It certainly is there to</p> <p>17 convey materials. But I don't see that</p> <p>18 it's a belt dryer. The drying comes from</p> <p>19 the chamber.</p> <p>20 Q So you wouldn't identify the</p> <p>21 pre-dryer in Hanisch as a belt dryer?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 form.</p> <p>24 A What is your definition of a</p> <p>25 belt dryer?</p>                                                                                                                                                                                                                                    |
| <p style="text-align: right;">Page 91</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form, beyond the scope of this</p> <p>3 deposition. You don't have to answer</p> <p>4 that.</p> <p>5 Q Do you have an opinion</p> <p>6 either way?</p> <p>7 MR. SCHENKER: Objection,</p> <p>8 form.</p> <p>9 A I'll smile.</p> <p>10 Q So you're not going to</p> <p>11 answer the question?</p> <p>12 A No. I've been directed to</p> <p>13 not answer the question.</p> <p>14 Q Do you still have Hanisch in</p> <p>15 front of you, Dr. van Schalkwijk?</p> <p>16 A Yes, I do.</p> <p>17 Q Can I direct you to Figure 1</p> <p>18 of Hanisch?</p> <p>19 A Okay.</p> <p>20 Q Now, there's a little box</p> <p>21 with a 28 next to it. You see what I'm</p> <p>22 talking about?</p> <p>23 A Yes. I see it with the big</p> <p>24 E4 in the middle.</p> <p>25 Q Yes.</p>                                                                                                                                | <p style="text-align: right;">Page 93</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Well, I would ask you what</p> <p>3 your definition of a belt dryer is next.</p> <p>4 Do you identify the</p> <p>5 pre-dryer as a belt dryer or do you not?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, vague, ambiguous.</p> <p>8 A I don't think very much of</p> <p>9 anything in here described in detail of</p> <p>10 what it is. This is -- it says "active</p> <p>11 materials separation system." This is</p> <p>12 not a schematic with specific items.</p> <p>13 This is a flowchart of materials starting</p> <p>14 with battery cells, grinding and</p> <p>15 eventually going to separated materials</p> <p>16 that are recovered and exhaust and an</p> <p>17 electrolyte that's condensed. This is</p> <p>18 just a flowchart. It's not meant to be a</p> <p>19 depiction of the system as would be</p> <p>20 constructed. This is not a schematic or</p> <p>21 a mechanical drawing, an engineering</p> <p>22 drawing. This is a flowchart.</p> <p>23 Q Are you familiar with what</p> <p>24 the little circle with a triangle in it,</p> <p>25 labeled 18, is in Figure 1?</p> |

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| <p style="text-align: right;">Page 94</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form.</p> <p>4 A That is I believe a valve.</p> <p>5 No. That's a pump.</p> <p>6 Q Could it be a circulation</p> <p>7 pump?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form, vague.</p> <p>10 A 18 is described as a</p> <p>11 circulation pump.</p> <p>12 Q And 32 is also described as</p> <p>13 a circulation pump; correct?</p> <p>14 A Yes.</p> <p>15 Q Would you understand the</p> <p>16 purpose of these two circulation pumps to</p> <p>17 facilitate ventilation in Hanisch's</p> <p>18 system?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form.</p> <p>21 A As things are being -- in</p> <p>22 28, as things are being evaporated, the</p> <p>23 circulation pump is removing them to a</p> <p>24 place where they are then -- in both the</p> <p>25 case of 18 and 32, they are passed to</p>                                                                                   | <p style="text-align: right;">Page 96</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 particularly whether he teaches a</p> <p>3 continuous process or a batch</p> <p>4 process.</p> <p>5 Q Are you still formulating</p> <p>6 your answer to my question?</p> <p>7 A I am, I am. And you were</p> <p>8 asking, what is the gas washing column?</p> <p>9 Q Correct.</p> <p>10 A After -- after the</p> <p>11 decomposition oven, the high temperature</p> <p>12 oven, 400 to 600 degrees, you've</p> <p>13 decomposed, for example, the</p> <p>14 polyvinylidene fluoride and the PVDF</p> <p>15 binder in both anode and cathode.</p> <p>16 And they have a lot of</p> <p>17 residue, including -- it's a</p> <p>18 fluorine-containing compound. And it may</p> <p>19 contain -- when you decompose PVDF, you</p> <p>20 can get some HF. So you want to put that</p> <p>21 through something that washes the gases;</p> <p>22 in other words, will neutralize HF and</p> <p>23 then allow a gas to go streaming through</p> <p>24 for extraction.</p> <p>25 See, there's a decomposition</p> |
| <p style="text-align: right;">Page 95</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 whether the vapor that's moved is passed</p> <p>3 to a condenser, ostensibly to recover</p> <p>4 electrolyte solvents.</p> <p>5 Q You say ostensibly.</p> <p>6 Are you unsure as to whether</p> <p>7 that's the purpose?</p> <p>8 A I'm sure that that's the</p> <p>9 purpose. But as to how well it can --</p> <p>10 and how much it can collect, I haven't</p> <p>11 done an economic analysis as to, is it</p> <p>12 even worth collecting?</p> <p>13 Q Understood.</p> <p>14 Do you see the reference to</p> <p>15 gas washing columns in this figure?</p> <p>16 A Yes.</p> <p>17 Q What is a gas washing</p> <p>18 column?</p> <p>19 MR. SCHENKER: Objection.</p> <p>20 I'm going to object to this one also</p> <p>21 under scope. Where in his</p> <p>22 declaration is he talking about --</p> <p>23 MR. WALLER: We'll get</p> <p>24 there. It's directly relevant to his</p> <p>25 opinion on what Hanisch teaches,</p> | <p style="text-align: right;">Page 97</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 between 400 and 600 degrees. The binder,</p> <p>3 for example, thus decomposes. And</p> <p>4 decomposed product is removed via the</p> <p>5 discharged pipe and taken to the gas</p> <p>6 washing column. And since that gas of</p> <p>7 decomposition from PVDF probably contains</p> <p>8 some HF, it is neutralized by reacting it</p> <p>9 with, for example, calcium oxide or</p> <p>10 calcium carbonate.</p> <p>11 Q So the way a gas washing</p> <p>12 column works is that there's airflow</p> <p>13 through this column?</p> <p>14 A Yes.</p> <p>15 Q Is that right?</p> <p>16 A Yes.</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form.</p> <p>19 Q Can this airflow be stopped,</p> <p>20 sort of stopped and started?</p> <p>21 MR. SCHENKER: Objection,</p> <p>22 vague, incomplete hypothetical.</p> <p>23 A If you have a valve there,</p> <p>24 you could theoretically stop it. But one</p> <p>25 might ask, why would you? You would just</p>                                         |

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| <p style="text-align: right;">Page 98</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 be causing a backload of gas. You're</p> <p>3 trying to move material which is why you</p> <p>4 have airflow and carrying this</p> <p>5 decomposed -- this gas from the</p> <p>6 decomposition of binder to carry it away</p> <p>7 to where it could be extracted. I</p> <p>8 suppose you could stop that with a valve.</p> <p>9 But depending upon -- again, this is just</p> <p>10 material flow. This doesn't show exactly</p> <p>11 how they're doing it.</p> <p>12 Q What does material flow mean</p> <p>13 to you?</p> <p>14 A Battery's coming in and</p> <p>15 recovered materials coming out and</p> <p>16 everything else collected and discarded.</p> <p>17 Q So it basically describes</p> <p>18 the fact that you've got batteries</p> <p>19 starting at End A, and it kind of ends up</p> <p>20 at End B, essentially; right?</p> <p>21 MR. SCHENKER: Objection to</p> <p>22 form.</p> <p>23 A Actual material you</p> <p>24 recovered and waste material that you</p> <p>25 discard.</p>                                                   | <p style="text-align: right;">Page 100</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A 55 to 57?</p> <p>3 Q Yes.</p> <p>4 Are you there?</p> <p>5 A I am.</p> <p>6 Q So it says here, "The active</p> <p>7 materials separation system preferably</p> <p>8 possesses a pre-dryer which is set up in</p> <p>9 the material flow behind the cell</p> <p>10 crushing device and before the oven."</p> <p>11 That's consistent with what</p> <p>12 we were talking about; right?</p> <p>13 A Yes.</p> <p>14 Q And this language also means</p> <p>15 that material is flowing through the</p> <p>16 pre-dryer; right?</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form.</p> <p>19 A Yes.</p> <p>20 Q Are you aware of any other</p> <p>21 places in the reference, the Hanisch</p> <p>22 reference where it talks about material</p> <p>23 flow?</p> <p>24 A Well, the whole description</p> <p>25 is, you know, batteries come in here and</p>                                                                                                                                                                                                                               |
| <p style="text-align: right;">Page 99</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q And the way Figure 1 works</p> <p>3 at a sort of high level, you've got the</p> <p>4 battery here. It goes through the cell</p> <p>5 crusher that we've talked about. Then it</p> <p>6 runs through this pre-dryer, which we've</p> <p>7 been talking about, makes it way through</p> <p>8 the separators that we've also talked</p> <p>9 about, and eventually to the</p> <p>10 decomposition oven and essentially out to</p> <p>11 the other end; is that how generally, it</p> <p>12 works?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form, mischaracterizes the reference.</p> <p>15 A The movement of material is</p> <p>16 going from upper left to out on the right</p> <p>17 with what you're trying to recover.</p> <p>18 Q And that's material flow?</p> <p>19 A That's material flow,</p> <p>20 Figure 1 of the Exhibit 1004.</p> <p>21 Q Let me take you to Column 4,</p> <p>22 lines 6, 7 and 8. Let me know when</p> <p>23 you're there. Actually, no. Let me</p> <p>24 bring you down to Column 4, lines 55, 56</p> <p>25 and 57.</p> | <p style="text-align: right;">Page 101</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 go through there; you know, even in</p> <p>3 Column 5 at 31, it refers to this</p> <p>4 Figure 1 as a flowchart of active</p> <p>5 materials separation system. But this is</p> <p>6 really just flow, material flow, material</p> <p>7 come in and recovered materials come out.</p> <p>8 And that's this whole description of</p> <p>9 Figure 1. It's just a separation system.</p> <p>10 It's just a flowchart of active materials</p> <p>11 separation system. You call it -- you</p> <p>12 know, I look at it and just see material</p> <p>13 flow. And if you read this, most people</p> <p>14 would say that it's describing the flow</p> <p>15 of the material. It's not describing for</p> <p>16 me what equipment is being used, just the</p> <p>17 types of functions that are happening</p> <p>18 here.</p> <p>19 MR. SCHENKER: Counsel, it's</p> <p>20 been another hour. Do you want to</p> <p>21 take a break?</p> <p>22 MR. WALLER: I can wrap up</p> <p>23 this line of questioning pretty</p> <p>24 quickly. Give me ten minutes?</p> <p>25 MR. SCHENKER: Sure.</p> |

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| <p style="text-align: right;">Page 102</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. WALLER: Great.</p> <p>3 MR. SCHENKER: Are we</p> <p>4 breaking for lunch after this?</p> <p>5 MR. WALLER: Yes. May as</p> <p>6 well, yes.</p> <p>7 Q So it's fair to say that the</p> <p>8 flowchart we've been talking about is</p> <p>9 discussing the flow of material in</p> <p>10 Hanisch; right?</p> <p>11 A That's how it appears to me.</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form.</p> <p>14 Q I will point you to a few</p> <p>15 additional areas in the reference that</p> <p>16 talk about material flow. There's quite</p> <p>17 a few of them. There's one on -- let's</p> <p>18 see. It's Column 4, line 61, which is</p> <p>19 talking about a magnetic separator in the</p> <p>20 material flow.</p> <p>21 I'll point you to Column 5,</p> <p>22 line 23, which is talking about an impact</p> <p>23 mill and in the direction of the material</p> <p>24 flow. I'll point you to the same column.</p> <p>25 A Wait a minute. 4 at?</p> | <p style="text-align: right;">Page 104</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 in the Hanisch reference where it</p> <p>3 describes material not flowing but</p> <p>4 instead stopping or halting?</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 form.</p> <p>7 A This is the overall material</p> <p>8 flow, Figure 1. Did you enter the</p> <p>9 pre-dryer with material moving on a</p> <p>10 continuous basis through the pre-drying</p> <p>11 process or did you put some material in</p> <p>12 there, close everything off and do it as</p> <p>13 a batch?</p> <p>14 That doesn't say it here.</p> <p>15 That doesn't say it in the description.</p> <p>16 So I think Hanisch is saying -- has said</p> <p>17 that this could be a batch process or</p> <p>18 preferably, a continuous process. But it</p> <p>19 doesn't -- this diagram doesn't lay out,</p> <p>20 and the description of what happens here</p> <p>21 does not lay out a continuous process or</p> <p>22 a batch process. Hanisch is basically</p> <p>23 saying when you devise your system, build</p> <p>24 your system. It could be either.</p> <p>25 Q Well, my question's a little</p> |
| <p style="text-align: right;">Page 103</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q 5 at 22.</p> <p>3 A What was the previous one?</p> <p>4 4 at what?</p> <p>5 Q It was 4 at 61.</p> <p>6 A Okay. And then 5 at who?</p> <p>7 Q And then 5 at 22.</p> <p>8 A Okay.</p> <p>9 Q And there's another one at 5</p> <p>10 and 49, talking about a stirred reactor</p> <p>11 can be set up in the direction of</p> <p>12 material flow.</p> <p>13 A Okay.</p> <p>14 Q And others.</p> <p>15 A And others. So it's</p> <p>16 basically what I've been saying. This is</p> <p>17 a flowchart of just the flow of material.</p> <p>18 Q Illustrating that materials</p> <p>19 are flowing through Hanisch; correct?</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 form, mischaracterizes the testimony.</p> <p>22 A Yes. But it's not</p> <p>23 describing a continuous process. It's</p> <p>24 describing a process.</p> <p>25 Q Are you aware of any places</p>                                                                                              | <p style="text-align: right;">Page 105</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 more narrow than that. I'm trying to</p> <p>3 understand whether Hanisch ever talks</p> <p>4 about the flow of materials stopping or</p> <p>5 halting in the reference, ever.</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, vague, asked and answered.</p> <p>8 A That's a pretty vague</p> <p>9 question because it says that the</p> <p>10 material enters the pre-dryer, but it</p> <p>11 doesn't say, okay, now we shut it off,</p> <p>12 and no more comes in. It would pre-dry</p> <p>13 this stuff. That level of description is</p> <p>14 not done here.</p> <p>15 MR. WALLER: Let's take a</p> <p>16 break for lunch.</p> <p>17 THE VIDEOGRAPHER: Off the</p> <p>18 record 12:59, marking the end of</p> <p>19 Media Unit No. 2.</p> <p>20 (A lunch recess was taken.)</p> <p>21 THE VIDEOGRAPHER: On the</p> <p>22 record at 14:04, beginning Media Unit</p> <p>23 No. 3.</p> <p>24 Q Welcome back, Dr. van</p> <p>25 Schalkwijk.</p>                                                                                                                              |

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| <p style="text-align: right;">Page 106</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A Thank you.</p> <p>3 Q During the break, did you</p> <p>4 discuss any of your previous testimony</p> <p>5 with anybody?</p> <p>6 A No.</p> <p>7 Q At the very start of our</p> <p>8 deposition, we spoke briefly about the</p> <p>9 Shin reference. Do you recall that?</p> <p>10 A I don't recall us mentioning</p> <p>11 Shin at the beginning of this deposition.</p> <p>12 Q Are you familiar with the</p> <p>13 Shin reference?</p> <p>14 A Yes. I just don't recall</p> <p>15 you mentioning it during today until now.</p> <p>16 We've talked Hayashi, we've talked about</p> <p>17 this and that. But we didn't talk</p> <p>18 about -- you never mentioned Shin, to my</p> <p>19 knowledge.</p> <p>20 Q What I'm referring to is at</p> <p>21 the start of the deposition, I listed off</p> <p>22 the patent number and asked if you would</p> <p>23 recognize it as the Shin reference.</p> <p>24 A Okay.</p> <p>25 Q You recall that?</p> | <p style="text-align: right;">Page 108</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A I have.</p> <p>3 Q And what's your opinion with</p> <p>4 regard to Shin?</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 form, vague.</p> <p>7 A Shin describes a lot of</p> <p>8 things they describe as either batch or</p> <p>9 continuous or could be either one. Shin</p> <p>10 describes specifically a batch process.</p> <p>11 Q Let me ask my question maybe</p> <p>12 a little bit more narrow and clearly.</p> <p>13 You don't offer an opinion</p> <p>14 in your declaration today anywhere that a</p> <p>15 POSITA would be motivated to incorporate</p> <p>16 Shin's vacuum into the Hanisch reference;</p> <p>17 correct?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 form, vague, mischaracterizes</p> <p>20 testimony.</p> <p>21 A State that again, about Shin</p> <p>22 and Hanisch.</p> <p>23 Q You don't offer an opinion</p> <p>24 in your declaration that you're</p> <p>25 testifying about today anywhere that a</p> |
| <p style="text-align: right;">Page 107</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 A Yeah. I often don't go by</p> <p>3 the number, like Hanisch is the 419.</p> <p>4 Q Understood.</p> <p>5 You don't offer any opinion</p> <p>6 in your declaration anywhere that a</p> <p>7 POSITA would be motivated to incorporate</p> <p>8 Shin's vacuum into Hanisch's process;</p> <p>9 right?</p> <p>10 MR. SCHENKER: Objection,</p> <p>11 form. I'm going to ask that you</p> <p>12 specify whether you're talking about</p> <p>13 this declaration or the prior</p> <p>14 declaration. It's a matter of scope.</p> <p>15 MR. WALLER: I'll ask,.</p> <p>16 Q Have you offered that</p> <p>17 opinion in this declaration, the</p> <p>18 declaration that you're testifying about</p> <p>19 today?</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 form.</p> <p>22 A And in what context would I</p> <p>23 have mentioned Shin?</p> <p>24 Q I'm just asking if you have</p> <p>25 mentioned Shin in this declaration.</p>                          | <p style="text-align: right;">Page 109</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 POSITA would be motivated to incorporate</p> <p>3 Shin's vacuum into the Hanisch reference?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form, mischaracterizes testimony.</p> <p>6 A I do mention specifically</p> <p>7 that the batch process of Shin would have</p> <p>8 been combined with the disclosures of</p> <p>9 Hanisch.</p> <p>10 Q Can you point me to where</p> <p>11 that is, that opinion is?</p> <p>12 A I state that in</p> <p>13 paragraph 52.</p> <p>14 Q Do you recall what vacuum</p> <p>15 level Shin teaches?</p> <p>16 MR. SCHENKER: Objection,</p> <p>17 form?</p> <p>18 Q If you'd like, Dr. van</p> <p>19 Schalkwijk, I can show you Shin to</p> <p>20 refresh your recollection. Would that be</p> <p>21 helpful?</p> <p>22 A That would be helpful.</p> <p>23 MR. WALLER: I'm showing the</p> <p>24 witness an exhibit that's previously</p> <p>25 been marked Exhibit 1010.</p>                                |

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| <p style="text-align: right;">Page 110</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q I would like to direct you</p> <p>3 to Column 8, lines 10, 11 and 12.</p> <p>4 MR. SCHENKER: And I'm going</p> <p>5 to object to the question as beyond</p> <p>6 the scope of the deposition, to the</p> <p>7 extent you're asking about Shin</p> <p>8 generally and not in the context of</p> <p>9 this declaration. Again, you had the</p> <p>10 opportunity to depose the witness on</p> <p>11 Shin in the prior deposition. And I</p> <p>12 believe you did depose him on Shin in</p> <p>13 the prior deposition. And this</p> <p>14 deposition is limited to what's in</p> <p>15 his declaration.</p> <p>16 MR. WALLER: And he</p> <p>17 identified a place in his deposition</p> <p>18 where he discussed the combination of</p> <p>19 Shin. So it's within the scope.</p> <p>20 MR. SCHENKER: So again, as</p> <p>21 long as it's limited to the opinions</p> <p>22 that he's offering here.</p> <p>23 MR. WALLER: Understood.</p> <p>24 A Shin's pulling a pretty</p> <p>25 intense vacuum done within five minutes</p> | <p style="text-align: right;">Page 112</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 declaration.</p> <p>3 MR. WALLER: Well, he</p> <p>4 identified that he has -- he's</p> <p>5 already identified a place in his</p> <p>6 declaration where he's opined on the</p> <p>7 combination. So I think this is</p> <p>8 within the scope. I would ask you to</p> <p>9 withdraw the objection.</p> <p>10 MR. SCHENKER: I'm not going</p> <p>11 to withdraw the objection because</p> <p>12 again, this is something that you had</p> <p>13 the opportunity to depose him on.</p> <p>14 And you did depose him on. And</p> <p>15 you're taking a second opportunity to</p> <p>16 depose him on something that was from</p> <p>17 an earlier declaration.</p> <p>18 MR. WALLER: He's</p> <p>19 incorporated his previous declaration</p> <p>20 into his new declaration. That makes</p> <p>21 it within the scope.</p> <p>22 MR. SCHENKER: He's saying</p> <p>23 that it's for the same reasons that</p> <p>24 he's offered earlier for reasons that</p> <p>25 you've deposed him on already. So if</p> |
| <p style="text-align: right;">Page 111</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 using a rotary pump. And your question</p> <p>3 about Shin relating to Hanisch is what?</p> <p>4 Q Well, now my question is</p> <p>5 just, what the vacuum level taught by</p> <p>6 Shin is.</p> <p>7 A It's very intense. Ten to</p> <p>8 the minus torr within five minutes and</p> <p>9 ten to the minus four torr is a pretty</p> <p>10 intense vacuum since 760 torr is one</p> <p>11 atmosphere. So this is a pretty intense</p> <p>12 vacuum.</p> <p>13 Q So what does it mean to have</p> <p>14 a ten to the negative four torr vacuum?</p> <p>15 What happens in a system when you have</p> <p>16 that sort of intense of a vacuum as</p> <p>17 you've testified?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 form, beyond the scope of his</p> <p>20 deposition. Again, you had the</p> <p>21 opportunity to depose the witness on</p> <p>22 Shin already with respect to the</p> <p>23 vacuum levels, and you did depose</p> <p>24 him. And this is not something</p> <p>25 that's covered in his second</p>          | <p style="text-align: right;">Page 113</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 you're asking him about his opinions</p> <p>3 here, what's in his declaration is</p> <p>4 there, going back to the original</p> <p>5 declaration. And getting a second</p> <p>6 shot at that is outside the scope of</p> <p>7 this deposition.</p> <p>8 Q Are you aware of any</p> <p>9 continuous process systems that operate</p> <p>10 at a vacuum level of 0.00013</p> <p>11 hectopascals?</p> <p>12 A Not specifically that</p> <p>13 number. But that's a pretty extreme</p> <p>14 vacuum as well.</p> <p>15 Q Are you aware of any</p> <p>16 continuous process systems that operate</p> <p>17 at an equivalent or similar vacuum level?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 vague, scope.</p> <p>20 A I haven't seen it in battery</p> <p>21 recycling. I've seen it in other</p> <p>22 materials recycling and other materials</p> <p>23 preparation. But you don't generally --</p> <p>24 yeah. I answered your question. I've</p> <p>25 seen it before.</p>                            |

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| <p style="text-align: right;">Page 114</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Not in the context of</p> <p>3 battery recycling; correct?</p> <p>4 A No.</p> <p>5 Q Have you seen anything</p> <p>6 similar in a batch process system?</p> <p>7 MR. SCHENKER: Objection,</p> <p>8 vague, scope.</p> <p>9 A I've seen it in a batch</p> <p>10 process system. But pulling that size of</p> <p>11 a vacuum on a big system in a big chamber</p> <p>12 is time consuming and expensive, and it</p> <p>13 requires a pretty intense pump.</p> <p>14 Q And this example you're</p> <p>15 talking about was not in the battery</p> <p>16 recycling?</p> <p>17 A No. But it was on other</p> <p>18 materials recycling.</p> <p>19 Q What are the components of a</p> <p>20 lithium-ion battery?</p> <p>21 MR. SCHENKER: Objection,</p> <p>22 form, outside the scope of his</p> <p>23 deposition again. That's something</p> <p>24 you could have and should have and I</p> <p>25 believe did depose him on earlier.</p> | <p style="text-align: right;">Page 116</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q I do not today, sir.</p> <p>3 Are you able to answer the</p> <p>4 question or are you not?</p> <p>5 A I can.</p> <p>6 Q Could you give me your best</p> <p>7 answer?</p> <p>8 A Okay.</p> <p>9 In the cathode, you have</p> <p>10 lithium, you have a metal oxide, which</p> <p>11 may be just one metal, like cobalt oxide,</p> <p>12 lithium cobalt. So lithium, cobalt and</p> <p>13 oxygen. But you might have the -- the</p> <p>14 cathode might be any metal oxide. It</p> <p>15 might be nickel cobalt, aluminum, it</p> <p>16 might be nickel manganese, it might be</p> <p>17 nickel manganese cobalt.</p> <p>18 And then to any of those,</p> <p>19 they have added amounts -- small amounts</p> <p>20 that don't ever appear in your</p> <p>21 stoichiometry and your formulae. They</p> <p>22 had small amounts of magnesium and</p> <p>23 titanium to the cathode structure for</p> <p>24 maybe less than 1 percent for</p> <p>25 conductivity and structural, the titanium</p>                                                                                                                   |
| <p style="text-align: right;">Page 115</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. WALLER: Are you taking</p> <p>3 the position that the components of a</p> <p>4 lithium-ion battery are outside the</p> <p>5 scope of his deposition?</p> <p>6 MR. SCHENKER: Are you</p> <p>7 asking specific to any opinions that</p> <p>8 he's rendered here?</p> <p>9 MR. WALLER: Virtually all</p> <p>10 of them. They all have to deal with</p> <p>11 the components of a lithium-ion</p> <p>12 battery. I think it's a fair</p> <p>13 question to ask.</p> <p>14 MR. SCHENKER: Okay. Tie it</p> <p>15 to his declaration. And then go</p> <p>16 ahead.</p> <p>17 MR. WALLER: We'll work</p> <p>18 towards it.</p> <p>19 Q What are the components of a</p> <p>20 lithium-ion battery?</p> <p>21 MR. SCHENKER: Objection,</p> <p>22 vague, calls for a narrative.</p> <p>23 A It is a big narrative. Do</p> <p>24 you have a copy of the periodic table</p> <p>25 with you?</p>                                              | <p style="text-align: right;">Page 117</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 basically holding a door open of the</p> <p>3 layers so lithium can move in and out.</p> <p>4 So there's the cathode.</p> <p>5 It also encompasses -- it</p> <p>6 could be comprised of lithium-ion</p> <p>7 phosphate, lithium manganese iron</p> <p>8 phosphate, different voltage, but still a</p> <p>9 lithium-ion system. The anode in</p> <p>10 99 percent of the cases is graphite. And</p> <p>11 the graphite might include some additives</p> <p>12 for conductivity. But the graphite might</p> <p>13 be alloyed or combined with various forms</p> <p>14 of silicon to give a higher capacity for</p> <p>15 the battery. So you might have graphite,</p> <p>16 silicon.</p> <p>17 There are other kinds of</p> <p>18 carbons, known as hard carbons, which are</p> <p>19 a little more dense but have a little bit</p> <p>20 of a different voltage profile that are</p> <p>21 also used but not as commonly as</p> <p>22 artificial graphite. Natural graphite</p> <p>23 has a lot of impurities. So it's not</p> <p>24 used as much, except in cheap batteries.</p> <p>25 So there's the anode.</p> |

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| <p style="text-align: right;">Page 118</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 The separator will be three</p> <p>3 layers of polypropylene and polyethylene</p> <p>4 layered because they have different</p> <p>5 melting points. And if a battery -- and</p> <p>6 they have a different pore structure.</p> <p>7 And the pores are partially filled with</p> <p>8 ceramic materials. The ceramic materials</p> <p>9 are there -- this is a narrative. The</p> <p>10 ceramic materials are there to absorb</p> <p>11 heat. So if the battery is overheating,</p> <p>12 the separator doesn't shrink and then</p> <p>13 cause an internal short circuit.</p> <p>14 The other thing is that at</p> <p>15 one other temperature range, one of the</p> <p>16 polymer components will melt, and it'll</p> <p>17 lose its pore structure. So you</p> <p>18 essentially shut out electrochemical</p> <p>19 reactivity. The binder for both</p> <p>20 electrodes is polyvinylidene fluoride,</p> <p>21 PVDF. It's there in a small</p> <p>22 concentration of about 3 percent. They</p> <p>23 also put in some what is called electric</p> <p>24 carbon. It doesn't participate in</p> <p>25 electrochemical reactions, but it adds to</p>             | <p style="text-align: right;">Page 120</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 nickel-plated cold weld steel with a</p> <p>3 header that's metallically compatible and</p> <p>4 some polymeric vents at the top, a little</p> <p>5 burp vent that if gas is generated on the</p> <p>6 inside, it burps and let's out gas. And</p> <p>7 that happens.</p> <p>8 And then the outside of the</p> <p>9 battery usually will have a polymeric</p> <p>10 heat shrink sleeve. The thin batteries</p> <p>11 that go into some of our electronic</p> <p>12 devices are encased in a mylar pouch and</p> <p>13 then flattened to make the thin --</p> <p>14 flattened under heat and pressure to</p> <p>15 flatten the battery, so that it could fit</p> <p>16 into these things.</p> <p>17 And then there's the</p> <p>18 electrolyte which will be a mixture of</p> <p>19 organic solvents and almost ubiquitously,</p> <p>20 LiPF6. Since the late '90s, they started</p> <p>21 putting in electrolyte additives that</p> <p>22 have certain functions during the early</p> <p>23 life of the battery. They generally</p> <p>24 don't list them on the materials safety</p> <p>25 data sheet or in their patents because</p> |
| <p style="text-align: right;">Page 119</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 the conductivity of both electrodes.</p> <p>3 Most commonly these days, it is comprised</p> <p>4 of crushed up carbon nano tubes. These</p> <p>5 are mixed to make a slurry and coated.</p> <p>6 The anode -- the graphite mixtures is</p> <p>7 coated on to copper foil. The cathode</p> <p>8 mixture is coiled on to aluminum foil.</p> <p>9 These two are chosen because of voltage</p> <p>10 compatibility of the materials and the</p> <p>11 voltage at which those electrodes</p> <p>12 operate. When the slurry is coated on to</p> <p>13 the metal foils, it goes through a very</p> <p>14 long, slow deliberate evaporation</p> <p>15 process, so that the solvents come off</p> <p>16 why you don't leave any bubbles behind.</p> <p>17 This is then rolled up into either a</p> <p>18 jellyroll to become a cylindrical battery</p> <p>19 or wound around a flat mandrel and then</p> <p>20 compressed to make a very thin battery</p> <p>21 like you would have in your phone or your</p> <p>22 thin laptop.</p> <p>23 Those are the major</p> <p>24 components. But the battery is encased,</p> <p>25 in the case of a cylindrical cell, into a</p> | <p style="text-align: right;">Page 121</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 that's all proprietary.</p> <p>3 And since those components</p> <p>4 are consumed in the first cycles of the</p> <p>5 battery, there is no way to look and find</p> <p>6 them. The competitors can't find them.</p> <p>7 So they have to understand them</p> <p>8 themselves. So that -- I can't think of</p> <p>9 anything else. But that is the contents</p> <p>10 of a lithium-ion battery.</p> <p>11 Q Is it fair to say that</p> <p>12 there's a fair amount of variety in what</p> <p>13 comprises a lithium-ion battery?</p> <p>14 A That's an understatement.</p> <p>15 Q Fair.</p> <p>16 A So it's complex.</p> <p>17 Q Understood.</p> <p>18 Once you open a lithium-ion</p> <p>19 battery, what sorts of reactions can</p> <p>20 occur, assuming it hasn't been</p> <p>21 discharged?</p> <p>22 MR. SCHENKER: Objection.</p> <p>23 I'm going to object as outside the</p> <p>24 scope, unless you tie this to where</p> <p>25 in his declaration you're asking him</p>                                                                                                                                                      |

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| <p style="text-align: right;">Page 122</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 about.</p> <p>3 MR. WALLER: I'm tying it</p> <p>4 to his opinions on paragraph 45 which</p> <p>5 will be my next line of inquiry. Are</p> <p>6 you instructing the witness not to</p> <p>7 answer the question?</p> <p>8 MR. SCHENKER: What's the</p> <p>9 question?</p> <p>10 Q Once you open a lithium-ion</p> <p>11 battery, what sorts of chemical reactions</p> <p>12 can occur?</p> <p>13 MR. SCHENKER: Vague. You</p> <p>14 could answer.</p> <p>15 THE WITNESS: Okay.</p> <p>16 A You tend not to want to open</p> <p>17 this -- if you open the battery in this</p> <p>18 room where it's humid, you allow all</p> <p>19 sorts of reactions that will be producing</p> <p>20 toxic gas.</p> <p>21 Generally, if the battery is</p> <p>22 in a high state of charge, the graphite</p> <p>23 is full of lithium and will react very</p> <p>24 violently with moisture and almost</p> <p>25 propagate. And you can have a fire.</p>                                                                                                                                                                   | <p style="text-align: right;">Page 124</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 with the lithiated graphite could be</p> <p>3 violent. Reacting with the salt can</p> <p>4 produce hydrogen fluoride, among other</p> <p>5 things, which is very corrosive, very</p> <p>6 toxic. And it doesn't react as much with</p> <p>7 the cathode. Most of the reactivity is</p> <p>8 with the solvent -- I mean with the salt</p> <p>9 in the solvent or with the lithiated</p> <p>10 graphite which is one of the reasons you</p> <p>11 discharge these before you open them up.</p> <p>12 Q Understood.</p> <p>13 In paragraph 45 of your</p> <p>14 declaration, you mention the Arrhenius</p> <p>15 relationship in thermodynamics. Do you</p> <p>16 see that?</p> <p>17 A Yes.</p> <p>18 Q What is the Arrhenius</p> <p>19 relationship in thermodynamics?</p> <p>20 A Well, every chemical</p> <p>21 reaction, every -- in many cases, there</p> <p>22 are a lot of other physical processes,</p> <p>23 are guided by this relationship between a</p> <p>24 pre-exponential number that is related</p> <p>25 to -- intrinsic to the reaction occurring</p>                                 |
| <p style="text-align: right;">Page 123</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 So generally, when the</p> <p>3 batteries are opened for experimental</p> <p>4 reasons or failure mode analysis or for</p> <p>5 recycling, they're done in a dry</p> <p>6 atmosphere. No need to have a room</p> <p>7 that's under a vacuum. That would be</p> <p>8 cost prohibitive.</p> <p>9 But generally, people build</p> <p>10 dry rooms everywhere. And to have that</p> <p>11 as the place we are opening and crushing</p> <p>12 batteries is common. But then you have</p> <p>13 the -- if you've now gotten rid of your</p> <p>14 moisture and these dry rooms are usually</p> <p>15 down to a humidity level of -- that's</p> <p>16 characterized by the dew point of like</p> <p>17 minus 60 degrees Celsius. So they're</p> <p>18 very, very dry. Employees can only go</p> <p>19 there for about 20 minutes at a time</p> <p>20 before they have to go take a break and</p> <p>21 drink water, literally.</p> <p>22 So if you're now just</p> <p>23 letting oxygen in there, the reactions</p> <p>24 are not going to be as violent. But</p> <p>25 water vapor reacting with the salts or</p> | <p style="text-align: right;">Page 125</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 and to the activation energy of whatever</p> <p>3 chemical reaction you're studying,</p> <p>4 activation energy, meaning what barrier,</p> <p>5 energy barrier has to be crossed before</p> <p>6 the reaction takes place.</p> <p>7 For something that's</p> <p>8 explosive or highly reactive, like water</p> <p>9 reacting with the salt or the lithiated</p> <p>10 graphite, the energy -- the activation</p> <p>11 energy is low. It happens quite</p> <p>12 spontaneously.</p> <p>13 But in studying any chemical</p> <p>14 reaction, they have found that there's a</p> <p>15 temperature factor. So there's the</p> <p>16 activation energy, and there's the</p> <p>17 temperature. And whenever you increase</p> <p>18 the temperature by 10 degrees, kind of</p> <p>19 like a rule of thumb, it's almost exact,</p> <p>20 the rate of that reaction will double.</p> <p>21 Or conversely, if you cool it by 10</p> <p>22 degrees, the rate of reaction will be cut</p> <p>23 in half. And that is valid over a wide</p> <p>24 range of temperatures.</p> <p>25 After a while, it deviates</p> |

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| <p style="text-align: right;">Page 126</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 because at the low temperatures, you</p> <p>3 might be like freezing. And at the high</p> <p>4 end, you might be boiling. But for</p> <p>5 chemical reactions, some might occur in</p> <p>6 that window between freezing and boiling,</p> <p>7 this rate -- this relationship holds. It</p> <p>8 can be the rate of evaporation, it can be</p> <p>9 the rate of reaction, it could be the</p> <p>10 rate of gas generation. But they all</p> <p>11 follow the Arrhenius relationship which</p> <p>12 is well-known to second-year students in</p> <p>13 chemistry in chemical engineering and</p> <p>14 would be well-known to a POSITA working</p> <p>15 in this field.</p> <p>16 Q So just to clarify, the</p> <p>17 Arrhenius relationship that we've been</p> <p>18 talking about is an equation; correct?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form.</p> <p>21 A It can basically be a form</p> <p>22 of an equation.</p> <p>23 Q Do you know what the</p> <p>24 equation is, sitting here today?</p> <p>25 MR. SCHENKER: Objection,</p>                                                  | <p style="text-align: right;">Page 128</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 equation to calculate the speed of a</p> <p>3 reaction?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 form.</p> <p>6 A If you've done a few</p> <p>7 empirical measurements, you can.</p> <p>8 Q But you would need to have</p> <p>9 done these additional measurements?</p> <p>10 A Or the data occurs in the</p> <p>11 literature.</p> <p>12 Q So you wouldn't be able to</p> <p>13 use the Arrhenius equation alone to</p> <p>14 calculate the speed of a reaction?</p> <p>15 MR. SCHENKER: Objection,</p> <p>16 form, ambiguous.</p> <p>17 A If I wanted to look at the</p> <p>18 rate of drying or the rate of -- you</p> <p>19 know, the rate of evaporation, I could</p> <p>20 measure it at how fast is it evaporating</p> <p>21 at two different temperatures, make my</p> <p>22 equations, understand my relationship of</p> <p>23 this process.</p> <p>24 And that would be the extent</p> <p>25 of the amount of experimentation I would</p>                                                                                                                                                              |
| <p style="text-align: right;">Page 127</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form.</p> <p>3 A It's got so many forms, the</p> <p>4 way it is set up. But I don't know which</p> <p>5 one I should quote. But it basically</p> <p>6 would have -- it's inversely related to</p> <p>7 the temperature. So there'd be one over</p> <p>8 T-1, minus one over T-2, two different</p> <p>9 temperatures. You would have the</p> <p>10 pre-exponential. And you would have --</p> <p>11 depending on whether you're down at the</p> <p>12 quantum level, whether you would use the</p> <p>13 Boltzmann constant, you would use the</p> <p>14 so-called ideal gas constant. And you</p> <p>15 would be comparing the rate at those two</p> <p>16 temperatures. And you'd need some sort</p> <p>17 of a number for the pre-exponential or</p> <p>18 activation energy.</p> <p>19 But if you're comparing two</p> <p>20 temperatures that are not widely far</p> <p>21 apart, the activation energy and</p> <p>22 pre-exponential are going to cancel each</p> <p>23 other out. So you're really just looking</p> <p>24 at the difference in rates.</p> <p>25 Q Can you use the Arrhenius</p> | <p style="text-align: right;">Page 129</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 do. Then anything between those two</p> <p>3 temperatures, I could say, well, it</p> <p>4 evaporated this fast at this temperature,</p> <p>5 this fast at this temperature. And based</p> <p>6 on being able to define an equation, I</p> <p>7 could predict it for any temperature in</p> <p>8 between and maybe temperatures even</p> <p>9 beyond a little bit, above or below.</p> <p>10 Q Does the Arrhenius equation</p> <p>11 apply to all chemical reactions?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 form, vague.</p> <p>14 A In principle, yes. Some</p> <p>15 chemical reactions are -- result in</p> <p>16 something that is precipitated out and is</p> <p>17 no longer in the same realm. It's not a</p> <p>18 liquid, it's not a gas. If something's</p> <p>19 precipitating out as a solid, the</p> <p>20 relationship is a little bit altered.</p> <p>21 But in general, the rate of</p> <p>22 that formation of that solid is also</p> <p>23 guided by the Arrhenius relationship. So</p> <p>24 it's basically as close as you can come</p> <p>25 to having a universal rate equation in</p> |

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| <p style="text-align: right;">Page 130</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 chemistry or physics.</p> <p>3 Q Do you know what a chemical</p> <p>4 equilibrium is?</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 vague.</p> <p>7 A Seriously asking that</p> <p>8 question? Yes.</p> <p>9 Q Under what conditions is an</p> <p>10 equilibrium reached?</p> <p>11 MR. SCHENKER: Objection,</p> <p>12 vague, incomplete hypothetical.</p> <p>13 A That is completely</p> <p>14 hypothetical.</p> <p>15 Q Well, again, you're being</p> <p>16 led by your counsel.</p> <p>17 A No. It is hypothetical. I</p> <p>18 mean it's hypothetical. What kind of</p> <p>19 reaction are you talking about?</p> <p>20 Q So you're not able to answer</p> <p>21 the question? It would depend on too</p> <p>22 many factors to be able to answer the</p> <p>23 question as it stands?</p> <p>24 MR. SCHENKER: Objection to</p> <p>25 that last question as well.</p>                                                                                                                        | <p style="text-align: right;">Page 132</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 you try, but if you open it in this room,</p> <p>3 which is fairly humid, that water vapor</p> <p>4 will just quickly want to react with what</p> <p>5 you're exposing. If you're in a dry</p> <p>6 room, you can safely handle these</p> <p>7 materials.</p> <p>8 Q So is water the only way</p> <p>9 that lithium hexafluorophosphate would</p> <p>10 degrade to form, hydrogen fluoride?</p> <p>11 MR. SCHENKER: Objection,</p> <p>12 form, vague.</p> <p>13 A That is the primary root. I</p> <p>14 don't usually consider other roots</p> <p>15 because they're not as common at all.</p> <p>16 Q Are you aware of any other</p> <p>17 roots, sitting here today?</p> <p>18 A Not off the top of my head.</p> <p>19 Q Can lithium</p> <p>20 hexafluorophosphate thermally decompose</p> <p>21 without the presence of water?</p> <p>22 A Almost everything can. And</p> <p>23 I would imagine, yes, LiPF<sub>6</sub> would. It</p> <p>24 would go to form, LiF, lithium fluoride</p> <p>25 and PF<sub>5</sub> gas.</p> |
| <p style="text-align: right;">Page 131</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q How is hydrogen fluoride</p> <p>3 generated when heating a lithium battery?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 vague.</p> <p>6 A There's two ways in general</p> <p>7 that it's formed. One is moisture</p> <p>8 reacting with the LiPF<sub>6</sub>, the salt. The</p> <p>9 other is from thermal decomposition of</p> <p>10 the binder, the polyvinylidene fluoride.</p> <p>11 Q And the reaction that you're</p> <p>12 talking about with this is lithium</p> <p>13 hexafluorophosphate, the LiPF<sub>6</sub> that I</p> <p>14 think you mentioned, is that called</p> <p>15 hydrolysis?</p> <p>16 A Reacting with moisture,</p> <p>17 that's hydrolysis.</p> <p>18 Q And the hydrolysis that</p> <p>19 we're talking about of this LiPF<sub>6</sub></p> <p>20 component, where does the water come</p> <p>21 from, typically?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 vague.</p> <p>24 A Upon opening the battery --</p> <p>25 and you can't have a perfectly dry room,</p> | <p style="text-align: right;">Page 133</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q Are these components</p> <p>3 volatile?</p> <p>4 A The gas is. PF<sub>5</sub>, lithium</p> <p>5 fluoride is a solid.</p> <p>6 Q You testified earlier that</p> <p>7 polyvinylidene fluoride, PVDF is used as</p> <p>8 a binder --</p> <p>9 A Polyvinylidene fluoride,</p> <p>10 yes. It is the fluorine analog to saran</p> <p>11 wrap, literally.</p> <p>12 Q And it can decompose; right?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 vague.</p> <p>15 A PVDF is one of the</p> <p>16 components that are removed during the</p> <p>17 high-temperature oven process in the</p> <p>18 recycling. It's a binder. It's holding</p> <p>19 the electrodes together. You need to get</p> <p>20 rid of it so you can recover them,</p> <p>21 inorganic components. And you have to</p> <p>22 burn this stuff off.</p> <p>23 Q Can it decompose in other</p> <p>24 ways, besides burning it off?</p> <p>25 MR. SCHENKER: Objection,</p>                                                                                       |

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| <p style="text-align: right;">Page 134</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 vague.</p> <p>3 A Not economically.</p> <p>4 Q Are there any I guess</p> <p>5 uneconomical ways that you're aware of?</p> <p>6 A You can dissolve it with</p> <p>7 some -- probably with some strong polar</p> <p>8 organic solvents. But you would also --</p> <p>9 that would defeat the purpose, because</p> <p>10 you would ruin the things that you're</p> <p>11 trying to recover.</p> <p>12 Q Would this form of</p> <p>13 decomposition result in hydrogen</p> <p>14 fluoride?</p> <p>15 A It can.</p> <p>16 Q Would burning it off result</p> <p>17 in hydrogen fluoride formation?</p> <p>18 A Likely some, yes.</p> <p>19 Q Do you know how high the</p> <p>20 temperatures would have to be to</p> <p>21 decompose PVDF by burning it?</p> <p>22 A The only data point that I</p> <p>23 have, other than looking up PVDF, is that</p> <p>24 these ovens -- as you see in Figure 1 of</p> <p>25 Hanisch, the oven operates at between 400</p>                 | <p style="text-align: right;">Page 136</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 burning them off in the recycling</p> <p>3 process?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 vague.</p> <p>6 A There's no chemical reaction</p> <p>7 by which -- in the context of lithium</p> <p>8 batteries, whether they're whole or</p> <p>9 partially taken apart, there's no other</p> <p>10 mechanism by which those solvent</p> <p>11 molecules will fall apart or decompose.</p> <p>12 Q Other than heating?</p> <p>13 A Other than heating.</p> <p>14 MR. SCHENKER: Objection.</p> <p>15 Q Does this heating</p> <p>16 decomposition result in hydrogen fluoride</p> <p>17 formation?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 vague.</p> <p>20 A Those solvent molecules do</p> <p>21 not contain fluorine. They contain</p> <p>22 hydrogen and carbon and sometimes</p> <p>23 nitrogen. But they don't contain</p> <p>24 fluorine. So they're not going to form</p> <p>25 HF.</p>                                                                                                                   |
| <p style="text-align: right;">Page 135</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 and 600 degrees C. And what happens in</p> <p>3 that oven is the decomposition of the</p> <p>4 PVDF. So somewhere in that temperature</p> <p>5 range, you're cooking off your PVDF.</p> <p>6 Q Understood.</p> <p>7 We also talked about how</p> <p>8 lithium-ion batteries have electrolyte</p> <p>9 solvents in them; right?</p> <p>10 A Yes.</p> <p>11 Q Do they decompose?</p> <p>12 MR. SCHENKER: Objection,</p> <p>13 vague.</p> <p>14 A If there's any residual,</p> <p>15 yeah, they will decompose.</p> <p>16 Q Explain any residual.</p> <p>17 A It's like maybe some that</p> <p>18 are absorbed on to the surface of dry</p> <p>19 particles and then reach the -- and are</p> <p>20 classified and then reach the high</p> <p>21 temperature oven. They will burn off at</p> <p>22 that point. But most of the recycling</p> <p>23 schemes recover those solvents.</p> <p>24 Q Would they decompose under</p> <p>25 any other circumstances, other than</p> | <p style="text-align: right;">Page 137</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q I want to direct you to the</p> <p>3 third sentence in your declaration where</p> <p>4 it says, "As explained in my initial</p> <p>5 declaration, a POSITA would have</p> <p>6 understood that drying at low</p> <p>7 temperatures would prevent the production</p> <p>8 of hydrogen fluoride."</p> <p>9 Do you see that?</p> <p>10 A Yes.</p> <p>11 Q And what's the basis for</p> <p>12 that opinion?</p> <p>13 MR. SCHENKER: Objection.</p> <p>14 Again, I'm going to object to that as</p> <p>15 outside the scope, to the extent</p> <p>16 you're asking him to explain his</p> <p>17 original declaration.</p> <p>18 A I would just say that the</p> <p>19 drying at low temperatures would inhibit</p> <p>20 from whatever reaction, from residual</p> <p>21 oxygen or whatever, the production of</p> <p>22 hydrogen fluoride. And again, that</p> <p>23 chemical reaction would be, since it's a</p> <p>24 gas reaction, described just a few lines</p> <p>25 down, by the Arrhenius relationship. You</p> |

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| <p style="text-align: right;">Page 138</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 go to a lower temperature. And you will</p> <p>3 slow the production of the hydrogen</p> <p>4 fluoride.</p> <p>5 Q You speak a lot about low</p> <p>6 temperatures in this paragraph.</p> <p>7 What do you mean by low</p> <p>8 temperatures?</p> <p>9 A I say lower temperatures.</p> <p>10 I'm not sure -- I did say low</p> <p>11 temperatures. Drying at low temperatures</p> <p>12 would prevent the production of hydrogen</p> <p>13 fluoride; in other words, maybe going all</p> <p>14 the way down to where you've almost have</p> <p>15 condensed your moisture.</p> <p>16 But staying below</p> <p>17 80 degrees, they have found that the</p> <p>18 chemical reactions forming HF are quite</p> <p>19 slow. And this is one of the reasons</p> <p>20 we're choosing that 80-degree threshold</p> <p>21 for the drying, the pre-drying.</p> <p>22 Q Would a POSITA believe that</p> <p>23 a temperature below 100 degrees result in</p> <p>24 almost no hydrogen fluoride?</p> <p>25 MR. SCHENKER: Objection,</p> | <p style="text-align: right;">Page 140</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form.</p> <p>3 A If you form hydrogen</p> <p>4 fluoride, it doesn't hang around. It's</p> <p>5 extremely reactive. It's going to find</p> <p>6 something to react with. I can corrode</p> <p>7 this, or I can corrode the lungs of the</p> <p>8 guy that's near it. It's really toxic,</p> <p>9 and it's really reactive, one of the most</p> <p>10 reactive things that are out there. So</p> <p>11 any -- you know, you also want to inhibit</p> <p>12 the formation, so that you don't corrode</p> <p>13 your recycling equipment.</p> <p>14 Q A relatively minimal amount</p> <p>15 of hydrogen fluoride could cause --</p> <p>16 A -- havoc.</p> <p>17 Q Yes.</p> <p>18 A I don't have a quantity for</p> <p>19 havoc. But that's what it would cause.</p> <p>20 Q In the same paragraph, you</p> <p>21 opine, "Lower temperatures during LiPF6</p> <p>22 evaporation, for example, have long been</p> <p>23 known to be desirable, given the</p> <p>24 reduction of hydrogen fluoride formation</p> <p>25 from the electrolyte."</p> |
| <p style="text-align: right;">Page 139</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form, vague.</p> <p>3 A 100 degrees is not below</p> <p>4 80 degrees. So it's going to be like,</p> <p>5 you know, 100 degrees, it's going to be</p> <p>6 four times faster than at 80 degrees.</p> <p>7 Going from 80 to 90 would double; going</p> <p>8 from 90 to 100 would double again. So a</p> <p>9 factor of four.</p> <p>10 Q Understood.</p> <p>11 When you talk about in this</p> <p>12 paragraph that the low temperatures would</p> <p>13 prevent the production of hydrogen</p> <p>14 fluoride, do you mean that they would</p> <p>15 prevent the production of all hydrogen</p> <p>16 fluoride?</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 vague.</p> <p>19 A I think prevent was -- the</p> <p>20 word prevent should have probably been</p> <p>21 inhibit or strongly inhibit.</p> <p>22 Q Do you know how much</p> <p>23 hydrogen fluoride would remain if it</p> <p>24 doesn't prevent its formation?</p> <p>25 MR. SCHENKER: Objection,</p>                                                            | <p style="text-align: right;">Page 141</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 And then you cite an</p> <p>3 exhibit, EX1004. Do you see where I'm</p> <p>4 at?</p> <p>5 A I see where you're at.</p> <p>6 Q I'm going to show you that</p> <p>7 exhibit.</p> <p>8 A Oh, boy.</p> <p>9 MR. WALLER: I'm showing the</p> <p>10 witness a document that's previously</p> <p>11 been marked Exhibit 1005.</p> <p>12 Q So to pose an actual</p> <p>13 question, is it your opinion that this</p> <p>14 reference is teaching that lithium</p> <p>15 hexafluorophosphate evaporation in the</p> <p>16 cited portions of that reference?</p> <p>17 MR. SCHENKER: Objection,</p> <p>18 form, vague.</p> <p>19 A Interesting. And your</p> <p>20 question again?</p> <p>21 Q Is it your opinion that Lain</p> <p>22 is teaching that lithium</p> <p>23 hexafluorophosphate evaporation is</p> <p>24 occurring in the cited portions of that</p> <p>25 reference?</p>                                                                                                                                                               |

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| <p style="text-align: right;">Page 142</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form, mischaracterizes testimony.</p> <p>4 A It is actually -- I have one</p> <p>5 word missing; for example, as I</p> <p>6 previously explained, lower temperatures</p> <p>7 during LiPF6 evaporation. It should say</p> <p>8 LiPF6 containing electrolyte evaporation.</p> <p>9 So it should be, "Or during evaporation</p> <p>10 of electrolytes containing LiPF6."</p> <p>11 So LiPF6 is a salt. You</p> <p>12 don't evaporate it. It's contained in</p> <p>13 the solvents. So it's actually the</p> <p>14 solvents that are evaporating.</p> <p>15 Q And with that change to the</p> <p>16 language, you would still contend that</p> <p>17 Lain supports the teaching that you</p> <p>18 assert?</p> <p>19 MR. SCHENKER: Objection,</p> <p>20 form</p> <p>21 A If you're evaporating the</p> <p>22 solvents slowly and you're not in the</p> <p>23 presence of water, you would slow the</p> <p>24 formation of hydrogen fluoride. Lain is</p> <p>25 trying to do something completely</p>                                                                                                     | <p style="text-align: right;">Page 144</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 is it fair to say then that Lain probably</p> <p>3 isn't the best reference for what you're</p> <p>4 trying to express in this portion of your</p> <p>5 declaration?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, vague, mischaracterizes</p> <p>8 testimony.</p> <p>9 A I think Lain is still fine.</p> <p>10 And I'm looking at Column 2, 2 to 27, the</p> <p>11 organic solvent used in this step to</p> <p>12 dissolve out the electrolyte preferably</p> <p>13 also contains no water. And this</p> <p>14 dissolution step is preferably performed</p> <p>15 at a temperature, which does not exceed</p> <p>16 60 degrees, for example, 60 degrees C.,</p> <p>17 so that potentially unstable electrolyte</p> <p>18 salts, such as lithium</p> <p>19 hexafluorophosphate, will not be</p> <p>20 degraded.</p> <p>21 So they're trying to recover</p> <p>22 that. But by staying below 60 degrees</p> <p>23 here, they're in a situation where they</p> <p>24 would not react. There is always going</p> <p>25 to be some moisture some place. They</p> |
| <p style="text-align: right;">Page 143</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 different here. This is an old</p> <p>3 chemistry, circa 2022, 2000 era. He's</p> <p>4 trying to recover the LIPF6. It's like</p> <p>5 old solvents like acetonitrile. And</p> <p>6 they're trying to recover the LIPO6 as an</p> <p>7 intact molecule that could be recycled</p> <p>8 and then used in an electrolyte again.</p> <p>9 And they're also using --</p> <p>10 and I said you could dissolve the binder</p> <p>11 with some expensive solvents like here,</p> <p>12 NMP, methyl pyridine -- whatever. It's</p> <p>13 extremely expensive, extremely toxic.</p> <p>14 And the reason for it is</p> <p>15 when you the electrodes and you coat them</p> <p>16 and then you have to dry them, and I said</p> <p>17 solely, a lithium-ion battery factory</p> <p>18 is -- can be about a third of a-mile</p> <p>19 long. And 80 percent of that is stage by</p> <p>20 stage by stage, drying and recovering of</p> <p>21 the NMP because it's extremely toxic. So</p> <p>22 like I said, you could recover the</p> <p>23 binder. But it's expensive to do so.</p> <p>24 Q Understood.</p> <p>25 To get back to my question,</p> | <p style="text-align: right;">Page 145</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 would not react very fast with the LIPF6</p> <p>3 and degrade it.</p> <p>4 So you would not -- as it</p> <p>5 says on line 7, the dissolution, such as</p> <p>6 the lithium hexafluorophosphate, are not</p> <p>7 degraded. So you're slowing down the</p> <p>8 reaction by being at 60 degrees as</p> <p>9 opposed to something higher.</p> <p>10 Q So just to clarify, you're</p> <p>11 maintaining that Lain is the appropriate</p> <p>12 reference here?</p> <p>13 MR. SCHENKER: Objection.</p> <p>14 A Lain is still fine for this.</p> <p>15 Q You also opine in this</p> <p>16 paragraph that rates of reaction slow by</p> <p>17 approximately half when the temperature</p> <p>18 is reduced by 10 degrees Celsius or</p> <p>19 approximately double if the temperature</p> <p>20 is increased by 10 degrees Celsius?</p> <p>21 MR. SCHENKER: Objection.</p> <p>22 A Yes.</p> <p>23 Q When you say that, do you</p> <p>24 mean all other things being equal?</p> <p>25 MR. SCHENKER: Objection,</p>                                                    |

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| <p style="text-align: right;">Page 146</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form.</p> <p>3 A If you take any reaction,</p> <p>4 any chemical reaction, run it at a</p> <p>5 certain temperature, and you run it 10</p> <p>6 degrees hotter, Celsius, it's going to</p> <p>7 happen twice as fast. If you do it 10</p> <p>8 degrees slower, things are going to be --</p> <p>9 or 10 degrees lower, things are going to</p> <p>10 be half as fast. So it's like down 10</p> <p>11 degrees, it takes twice as long. Go up</p> <p>12 10 degrees, and it happens twice as fast.</p> <p>13 So it's a doubling effect for each 10</p> <p>14 degrees.</p> <p>15 So by understanding that</p> <p>16 you're looking at the rate of formation</p> <p>17 of hydrogen fluoride if LIPF6 was</p> <p>18 reacting with water and even tiny bits of</p> <p>19 water. If you did this at certain</p> <p>20 temperatures and they determined that</p> <p>21 would be in Lain, 60 degrees, that the</p> <p>22 formation of -- the Li-F formation would</p> <p>23 be a fourth of the rate if they did it at</p> <p>24 80 degrees. They don't compare it at</p> <p>25 80 degrees. They just decided that 60</p> | <p style="text-align: right;">Page 148</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 you have now -- are reacting half as much</p> <p>3 and half as much, versus whole and whole.</p> <p>4 Q Sure.</p> <p>5 Let's take another one.</p> <p>6 If the temperature goes up,</p> <p>7 but the concentration of reaction</p> <p>8 products also goes up, same deal; right?</p> <p>9 It would change the calculus?</p> <p>10 MR. SCHENKER: Objection --</p> <p>11 A It would change the</p> <p>12 calculus.</p> <p>13 MR. SCHENKER: -- form.</p> <p>14 Q So I guess just to</p> <p>15 summarize, all things being equal, your</p> <p>16 testimony is that hydrolysis of this</p> <p>17 lithium hexafluorophosphate at 80 degrees</p> <p>18 Celsius will be slower than at</p> <p>19 100 degrees Celsius; right?</p> <p>20 MR. SCHENKER: Objection,</p> <p>21 the form.</p> <p>22 A Yes.</p> <p>23 Q Do you know what the rate is</p> <p>24 at 100 degrees Celsius?</p> <p>25 MR. SCHENKER: Objection,</p>                               |
| <p style="text-align: right;">Page 147</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 was good enough.</p> <p>3 Q But there are other factors,</p> <p>4 aside from temperature, that could change</p> <p>5 the rate; right?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 form, vague.</p> <p>8 A If you had a catalyst in</p> <p>9 there, it could affect the rate. That's</p> <p>10 the whole purpose of catalysts sometimes.</p> <p>11 But why would you catalyze that reaction</p> <p>12 to take place? You would like to inhibit</p> <p>13 because you don't want it to happen.</p> <p>14 Q Well, let's take an example.</p> <p>15 Let's say, for example, that</p> <p>16 the temperature goes up but the</p> <p>17 concentration of reactants goes down.</p> <p>18 MR. SCHENKER: Objection.</p> <p>19 A You changed the game.</p> <p>20 Q So that would change the</p> <p>21 calculus?</p> <p>22 MR. SCHENKER: Objection,</p> <p>23 vague.</p> <p>24 A It changes the calculus</p> <p>25 because you changed the reaction because</p>                                                                                                                                                             | <p style="text-align: right;">Page 149</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 form.</p> <p>3 A No. My stopwatch corroded.</p> <p>4 And I haven't measured it. So, no, I</p> <p>5 don't know.</p> <p>6 Q How would you go about</p> <p>7 calculating that?</p> <p>8 A Empirically, you could</p> <p>9 generate --</p> <p>10 THE WITNESS: Am I waiting</p> <p>11 for you to object?</p> <p>12 MR. SCHENKER: I would say</p> <p>13 objection, form.</p> <p>14 THE WITNESS: Okay.</p> <p>15 A I don't want to touch the HF</p> <p>16 that's being formed. But if I put out</p> <p>17 something that it could react with and</p> <p>18 sequester or I bubbled my HF into some</p> <p>19 water and I measured the pH, that becomes</p> <p>20 my measurable piece of data. And I could</p> <p>21 watch how fast the pH changes, depending</p> <p>22 upon how fast the gas is generating.</p> <p>23 Now, if I was doing it at</p> <p>24 100 degrees, my pH is going like that.</p> <p>25 If I did it at 80 degrees and I'm not</p> |

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| <p style="text-align: right;">Page 150</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 generating HF as fast, my pH might be</p> <p>3 going up slower. So there are ways of</p> <p>4 finding a metric that you could use.</p> <p>5 Q Is it fair to say that doing</p> <p>6 so would require analysis of a variety of</p> <p>7 factors?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form, calls for undue speculation.</p> <p>10 A A few factors, not a big</p> <p>11 variety.</p> <p>12 Q More than one?</p> <p>13 A It would be more than one</p> <p>14 and devising a metric. I just popped out</p> <p>15 of my head, pH.</p> <p>16 Q Right. Understood.</p> <p>17 So I suppose by the</p> <p>18 reasoning in your declaration, hydrolysis</p> <p>19 of hexafluorophosphate at 80 degrees</p> <p>20 Celsius should also be slower than at</p> <p>21 70 degrees Celsius. Do I have that</p> <p>22 right?</p> <p>23 MR. SCHENKER: Objection,</p> <p>24 vague.</p> <p>25 A At 80 versus 70? What</p> | <p style="text-align: right;">Page 152</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 80 degrees Celsius, a POSITA would have</p> <p>3 understood that almost no hydrogen</p> <p>4 fluoride is produced in the drying</p> <p>5 process of Hanisch as acknowledged by the</p> <p>6 '097 patent."</p> <p>7 Do you see that?</p> <p>8 A Which line? Which</p> <p>9 paragraph?</p> <p>10 Q That's paragraph 47. And</p> <p>11 it's the last sentence of the paragraph.</p> <p>12 A Okay. Yes. Almost no</p> <p>13 hydrogen fluoride is produced during the</p> <p>14 drying process.</p> <p>15 Q So if I'm understanding your</p> <p>16 testimony correctly, if lower temperature</p> <p>17 just slows the reaction down, how do you</p> <p>18 know that almost no hydrogen fluoride</p> <p>19 would be produced below this 80 degrees</p> <p>20 Celsius number?</p> <p>21 MR. SCHENKER: Objection,</p> <p>22 form.</p> <p>23 A Well, almost no is a vague</p> <p>24 number, is indefinite. If you're</p> <p>25 producing -- if you're going below</p>                                                                                                                           |
| <p style="text-align: right;">Page 151</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 temperatures did you just say?</p> <p>3 Q Yes. 80 versus 70.</p> <p>4 A 70 will be slower.</p> <p>5 Q And then it would be the</p> <p>6 inverse?</p> <p>7 A Yes.</p> <p>8 Q Understood.</p> <p>9 So 60 would be slower than</p> <p>10 70?</p> <p>11 A Yes.</p> <p>12 Q I have it right now.</p> <p>13 A Good. Just remember that</p> <p>14 when you're making your hard-boiled eggs.</p> <p>15 Q So I guess kind of boiling</p> <p>16 this down, the lower the temperature</p> <p>17 goes, the slower the reaction should be;</p> <p>18 right?</p> <p>19 A You got a gold star on your</p> <p>20 forehead.</p> <p>21 Q Thank you.</p> <p>22 You also state in</p> <p>23 paragraph 47 of your declaration that "By</p> <p>24 teaching drying at temperatures below</p> <p>25 100 degrees Celsius, in particular below</p>                                                                                    | <p style="text-align: right;">Page 153</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 80 degrees, then you've apparently got</p> <p>3 the reaction to a point where the amount</p> <p>4 of HF that is being generated is -- does</p> <p>5 not have consequence to your equipment,</p> <p>6 your personnel or your other processes.</p> <p>7 And that would be my</p> <p>8 definition of almost no. You are going</p> <p>9 to generate some hydrogen fluoride. But</p> <p>10 it's going to be in small quantities.</p> <p>11 And without a little bit of</p> <p>12 experimentation, you don't know exactly</p> <p>13 what that number is.</p> <p>14 Q So why did you choose the</p> <p>15 phrase, almost no, in this declaration?</p> <p>16 MR. SCHENKER: Objection,</p> <p>17 form.</p> <p>18 A Well, I'm just checking to</p> <p>19 see if that almost no came from</p> <p>20 Exhibit 1004, Hanisch. But it didn't.</p> <p>21 It came out of me. If you were forming</p> <p>22 significant amounts of HF, you would have</p> <p>23 a lot of other complications to your</p> <p>24 equipment, to your -- it would be</p> <p>25 detrimental to your equipment if you were</p> |

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| <p style="text-align: right;">Page 154</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/> 2 generating a lot of hydrogen fluoride.<br/> 3 If you had slowed that process to a very,<br/> 4 very low amount of hydrogen fluoride<br/> 5 being generated, then you're basically<br/> 6 safe to operate because below 80 degrees<br/> 7 C, the reaction is so slow that it's<br/> 8 producing, again -- the weasel words --<br/> 9 almost no hydrogen fluoride.<br/> 10 Q So I suppose exercising my<br/> 11 gold star.<br/> 12 If the lower the temperature<br/> 13 goes, the slower the reaction, why would<br/> 14 a POSITA believe that they need to stay<br/> 15 at this 80 degrees Celsius number? Why<br/> 16 wouldn't they just keep going lower and<br/> 17 lower and lower?<br/> 18 MR. SCHENKER: Objection,<br/> 19 form, mischaracterizes testimony.<br/> 20 A A couple of reasons. One,<br/> 21 going lower and lower probably<br/> 22 wouldn't -- you're bouncing the need to<br/> 23 evaporate and dry in your pre-drying.<br/> 24 You're balancing the need to get that<br/> 25 done in a timely basis with need not to</p> | <p style="text-align: right;">Page 156</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/> 2 MR. SCHENKER: Objection,<br/> 3 form.<br/> 4 A In a closed container or<br/> 5 even out here in the atmosphere, yes. It<br/> 6 depends on pressure. If you have high<br/> 7 pressure or you're in a vessel and you're<br/> 8 generating a lot of pressure in there,<br/> 9 your evaporation rate is going to be<br/> 10 slower.<br/> 11 So you got a chamber that's<br/> 12 got some -- and you're pulling a vacuum<br/> 13 out of this chamber. So you're at a<br/> 14 lower pressure anyway. So evaporation's<br/> 15 going to proceed at a decent rate.<br/> 16 So pressure is one of the<br/> 17 variables that you could be -- you could<br/> 18 plug concentrations into the Arrhenius<br/> 19 equation, or you could put in partial<br/> 20 pressures. You could put in pressure,<br/> 21 pressure of O2, pressure of this,<br/> 22 pressure of that. And if I were holding<br/> 23 my pressures low, then the evaporation<br/> 24 rate could be high. If I'm having high<br/> 25 pressure, then I'm inhibiting</p> |
| <p style="text-align: right;">Page 155</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/> 2 corrode the daylights out of everything<br/> 3 by forming HF. So I've got my HF under<br/> 4 control at a certain rate below 80s. But<br/> 5 if I go way below 80 degrees, it's going<br/> 6 to take -- if I go to 60 degrees, my time<br/> 7 of pre-drying is going to be four times<br/> 8 longer, 80 to 70 to 60.<br/> 9 Q So you'd effectively be<br/> 10 balancing the sort of temperature with<br/> 11 the evaporation of the solvents,<br/> 12 effectively?<br/> 13 MR. SCHENKER: Objection to<br/> 14 form.<br/> 15 A The evaporation of the<br/> 16 solvents, which you want, and not forming<br/> 17 so much HF, stuff that you don't want.<br/> 18 So you're basically finding a sweet spot<br/> 19 where you can get your pre-drying in a<br/> 20 reasonable amount of time without<br/> 21 producing too much HF that's affecting<br/> 22 your equipment and processes.<br/> 23 Q The speed of the evaporation<br/> 24 of electrolyte solvents depends on<br/> 25 pressure; right?</p>                                          | <p style="text-align: right;">Page 157</p> <p>1 DR. WALTER VAN SCHALKWIJK<br/> 2 evaporation.<br/> 3 Q The speed of evaporation of<br/> 4 any absorbed amount of water in the<br/> 5 battery would also depend on this<br/> 6 pressure we've been talking about; right?<br/> 7 MR. SCHENKER: Objection,<br/> 8 form, vague.<br/> 9 A Speed of evaporation of?<br/> 10 Q Of any absorbed amount of<br/> 11 water in the battery.<br/> 12 A This gets a little bit more<br/> 13 complex because water -- water will do a<br/> 14 couple of things here. Water might<br/> 15 adsorb, it might react, and it might just<br/> 16 dissolve. Water will dissolve in these<br/> 17 organic solvents. But water would then<br/> 18 be reacting with the LIPF6.<br/> 19 So water's playing a few<br/> 20 roles here. And it's almost like you<br/> 21 have to break out the different reactions<br/> 22 that are taking place. But the dominant<br/> 23 ones are water reacting with LIPF6 to<br/> 24 form HF and how fast is the rest of the<br/> 25 solvents, how fast are they evaporating?</p>                    |

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| <p style="text-align: right;">Page 158</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 You cannot stop -- since you have some</p> <p>3 water vapor, the only way to stop that or</p> <p>4 slow it is to remove the water. And</p> <p>5 that's one of the reasons they're pulling</p> <p>6 the vacuum all the time.</p> <p>7 Q So pressure would have some</p> <p>8 impact?</p> <p>9 A It would have some impact.</p> <p>10 Q Just to finish my thought,</p> <p>11 it's dependent on a lot of other factors,</p> <p>12 though?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form.</p> <p>15 A Yes.</p> <p>16 MR. SCHENKER: Counsel,</p> <p>17 we've gone for about an hour now.</p> <p>18 Can we take a break?</p> <p>19 MR. WALLER: We can take a</p> <p>20 break.</p> <p>21 THE VIDEOGRAPHER: Off the</p> <p>22 record at 15:90, ending Media Unit</p> <p>23 No. 3.</p> <p>24 (A short recess was taken.)</p> <p>25 THE VIDEOGRAPHER: Off the</p>                                                                                                                     | <p style="text-align: right;">Page 160</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 specification must provide a numerical</p> <p>3 measurement for what it considers to be</p> <p>4 almost no hydrogen fluoride?</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 form.</p> <p>7 A I think -- no. I know that</p> <p>8 if you make a statement like this, you</p> <p>9 have to have some way of quantifying it.</p> <p>10 If you're saying that, okay, we're</p> <p>11 choosing this temperature because almost</p> <p>12 no hydrogen fluoride is produced, but how</p> <p>13 do we come to that conclusion? We had to</p> <p>14 have somewhere done -- you know, you</p> <p>15 can't have undue experimentation, blah,</p> <p>16 blah, blah, on your claims. But someone</p> <p>17 somewhere developing the system had to</p> <p>18 have measured something, whether it was</p> <p>19 pH or whatever, had to measure something</p> <p>20 about the rate at which hydrogen fluoride</p> <p>21 is produced.</p> <p>22 But if you then developed</p> <p>23 your system and say, okay, you know, at</p> <p>24 this temperature, almost no hydrogen</p> <p>25 fluoride is produced. And a POSITA</p> |
| <p style="text-align: right;">Page 159</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 record at 15:32, beginning Media Unit</p> <p>3 No. 4.</p> <p>4 Q Welcome back, Dr. van</p> <p>5 Schalkwijk.</p> <p>6 As I've asked the last</p> <p>7 couple of breaks, I want to inquire, did</p> <p>8 you speak with anybody about the contents</p> <p>9 of your testimony so far today?</p> <p>10 A No.</p> <p>11 Q I want to direct you to</p> <p>12 paragraph 69 of your declaration. Let me</p> <p>13 know when you're there.</p> <p>14 A Okay.</p> <p>15 Q So you provide the opinion</p> <p>16 here that the scope of the limitation,</p> <p>17 almost no hydrogen fluoride is produced,</p> <p>18 is not clear with reasonable certainty to</p> <p>19 a POSITA because a POSITA would not</p> <p>20 understand when almost no hydrogen</p> <p>21 fluoride is produced; is that correct?</p> <p>22 A That's what it says here.</p> <p>23 Q Is it your understanding</p> <p>24 that for the claim language, almost no</p> <p>25 hydrogen fluoride to be definite, the</p> | <p style="text-align: right;">Page 161</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 understood why the POSITA wouldn't have</p> <p>3 to redo the experimentation. Unless the</p> <p>4 system size and everything else changed,</p> <p>5 the POSITA would -- you know, could</p> <p>6 understand it. But if you just told me</p> <p>7 almost no hydrogen fluoride is produced,</p> <p>8 that's not a definite term. You don't</p> <p>9 have reasonable certainty without at</p> <p>10 least some measurement.</p> <p>11 Q Are you aware of methods for</p> <p>12 measuring hydrogen fluoride gas?</p> <p>13 MR. SCHENKER: Objection,</p> <p>14 form.</p> <p>15 A Again, you don't do it by</p> <p>16 collecting the gas. You do it by</p> <p>17 bubbling the gas through water and</p> <p>18 watching the change in pH.</p> <p>19 Q And that's a method for</p> <p>20 measuring hydrogen fluoride gas?</p> <p>21 A Yeah. And the reason for</p> <p>22 that, yes, is because you don't want to</p> <p>23 say I smell it, oh, now I'm dead, or you</p> <p>24 don't want to say, oh, I corroded all of</p> <p>25 my equipment, let's start over, let's</p>                                      |

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| <p style="text-align: right;">Page 162</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 bubble something through when we're</p> <p>3 characterizing our design, and we find,</p> <p>4 okay, if I go down to 60 degrees, then</p> <p>5 I've got like one bubble coming through,</p> <p>6 one bubble coming through, one bubble</p> <p>7 coming through and almost none, whereas</p> <p>8 if I'm at 100 degrees, I'm seeing bubble,</p> <p>9 bubble, bubble, and my pH is changing</p> <p>10 quickly.</p> <p>11 Q How long has this method of</p> <p>12 measurement been known in the art?</p> <p>13 MR. SCHENKER: Objection to</p> <p>14 form.</p> <p>15 A For a lot of reactive gases,</p> <p>16 like not just hydrogen fluoride, but</p> <p>17 hydrogen chloride, which is also a</p> <p>18 hydrochloric acid, is actually a</p> <p>19 dissolved gas or various other materials</p> <p>20 that you don't want to touch, having them</p> <p>21 go through and affect pH is a very</p> <p>22 common -- predates my being a scientist.</p> <p>23 Q So over ten years, over 20</p> <p>24 years? I'm trying to be flattering.</p> <p>25 A Yeah. It's been around for</p> | <p style="text-align: right;">Page 164</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 hydrogen fluoride. And that goes back</p> <p>3 older than me.</p> <p>4 Q Right.</p> <p>5 Do you know whether hydrogen</p> <p>6 fluoride has an odor? Does it stink?</p> <p>7 A I wouldn't want to try. I'm</p> <p>8 dead, yeah, it stunk. I don't know if it</p> <p>9 has an odor. And that's why its</p> <p>10 detection and the care to not generate it</p> <p>11 in the open is part of the safety</p> <p>12 protocols for it. So I'm sure that there</p> <p>13 are all sorts. There's probably OSHA</p> <p>14 documents about it for sure.</p> <p>15 Q But you don't know anything</p> <p>16 about sort of the odor of hydrogen</p> <p>17 fluoride or the detection by odor or</p> <p>18 anything to that?</p> <p>19 MR. SCHENKER: Objection.</p> <p>20 A I'm sure it's not done by</p> <p>21 odor.</p> <p>22 Q Understood.</p> <p>23 In Hanisch, what components</p> <p>24 would you expect to see evaporated in the</p> <p>25 pre-dryer phase?</p>                                                                                                               |
| <p style="text-align: right;">Page 163</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 a long time.</p> <p>3 Q So over 20 years?</p> <p>4 A Easily, yes.</p> <p>5 Q You testified earlier that</p> <p>6 hydrogen fluoride is quite hazardous;</p> <p>7 correct?</p> <p>8 MR. SCHENKER: Objection,</p> <p>9 form.</p> <p>10 A Very corrosive, very toxic.</p> <p>11 Q Are you aware of whether</p> <p>12 there are standard limits for human</p> <p>13 exposure to hydrogen fluoride?</p> <p>14 MR. SCHENKER: Objection.</p> <p>15 A There are. I don't know</p> <p>16 them offhand. But they're published, and</p> <p>17 they exist. And they would probably be</p> <p>18 posted at any company that would either</p> <p>19 use them or generate them.</p> <p>20 Q Do you have any sense of how</p> <p>21 long those have been around?</p> <p>22 A A lot longer than 20 years</p> <p>23 because one of the uses of hydrogen</p> <p>24 fluoride is to etch glass, so that people</p> <p>25 who do etching of glass have used</p>                                                                                                                                     | <p style="text-align: right;">Page 165</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 form, vague.</p> <p>4 A I would like to see the</p> <p>5 electrolyte, the solvents of the</p> <p>6 electrolyte come off. If just the</p> <p>7 solvents were coming off, that would</p> <p>8 leave the LiPF6 behind. And that LiPF6</p> <p>9 would be crystal, and it would be like</p> <p>10 salt crystals and present in whatever the</p> <p>11 dried material is.</p> <p>12 So when it becomes an</p> <p>13 active -- inactivated, you still got the</p> <p>14 salt of the LiPF6. But the material's</p> <p>15 inactivated because there's no way of</p> <p>16 making those lithium-ions move because</p> <p>17 there's no solvent anymore. You</p> <p>18 evaporated that off. But you got the</p> <p>19 LiPF6 salt and your electrode materials,</p> <p>20 your anode and your cathode.</p> <p>21 At some point, those are</p> <p>22 separated from each other. They can</p> <p>23 survive if it's dry. They can survive</p> <p>24 the classifiers. But then they're going</p> <p>25 to get to the big oven. And that's where</p> |

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| <p style="text-align: right;">Page 166</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 they're going to decompose.</p> <p>3 Q You testified earlier about</p> <p>4 certain volatile components in a</p> <p>5 lithium-ion battery; correct?</p> <p>6 MR. SCHENKER: Objection,</p> <p>7 vague.</p> <p>8 A Yes.</p> <p>9 Q And you testified earlier</p> <p>10 about the speed of evaporation of certain</p> <p>11 components, depending partially on</p> <p>12 pressure; correct?</p> <p>13 MR. SCHENKER: Objection.</p> <p>14 A Partially on pressure.</p> <p>15 Q Would the speed of</p> <p>16 evaporation of these sort of volatile</p> <p>17 components also depend on the pressure?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 vague, lacks foundation.</p> <p>20 A They do. And that is one</p> <p>21 reason you use a reduced pressure. If</p> <p>22 you're on a reduced pressure, things will</p> <p>23 want to evaporate because there's a place</p> <p>24 for them to go fill.</p> <p>25 Q If the drying were carried</p>                                               | <p style="text-align: right;">Page 168</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection,</p> <p>3 vague, lacks foundation.</p> <p>4 A It could. But you would</p> <p>5 also want to take precautions to keep it</p> <p>6 from ruining your pump.</p> <p>7 Q What sort of precautions</p> <p>8 would you need to take?</p> <p>9 A You would put it in line</p> <p>10 trap with, say, liquid nitrogen, so that</p> <p>11 the HF coming across would just be</p> <p>12 condensed into a liquid form. And then</p> <p>13 you could valve shut that off and dispose</p> <p>14 of it.</p> <p>15 But that way, HF is not</p> <p>16 going through the pump and ruining your</p> <p>17 valuable and expensive components. And</p> <p>18 that's common. That's not rocket</p> <p>19 science. People are using these kind of</p> <p>20 vapor traps for a lot of things,</p> <p>21 including in some of the patents here</p> <p>22 where they're recovering the solvents.</p> <p>23 They're condensing them.</p> <p>24 Q Do you have an example in</p> <p>25 any one of the patents?</p> |
| <p style="text-align: right;">Page 167</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 out under a vacuum, would you need to</p> <p>3 have a pump to maintain that vacuum?</p> <p>4 MR. SCHENKER: Objection,</p> <p>5 vague, lack of foundation.</p> <p>6 A Depends on your setup of</p> <p>7 whether you're doing it in one chamber or</p> <p>8 two chambers or three chambers. But if</p> <p>9 you're just doing it with one chamber, no</p> <p>10 extra locks, rotary locks or anything</p> <p>11 like that, you just did it all in one</p> <p>12 chamber. Pulling that extreme vacuum</p> <p>13 would be time and -- time consuming,</p> <p>14 energy consuming and, therefore, by</p> <p>15 extension, money consuming.</p> <p>16 Q Understood.</p> <p>17 But to draw the vacuum, you</p> <p>18 would need a pump?</p> <p>19 A You would need a vacuum</p> <p>20 pump.</p> <p>21 Q If hydrogen fluoride were</p> <p>22 produced during drying, this sort of</p> <p>23 vacuum would effectively remove the</p> <p>24 hydrogen fluoride from the dryer;</p> <p>25 correct?</p> | <p style="text-align: right;">Page 169</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 MR. SCHENKER: Objection.</p> <p>3 A Figure 1.</p> <p>4 Q Of Hanisch?</p> <p>5 A Condenser. To the right of</p> <p>6 No. 28, you got the condenser where the</p> <p>7 electrolyte components, the solvents are</p> <p>8 coming off during the pre-dryer. And</p> <p>9 then you're going to condense the organic</p> <p>10 solvents which are -- have value and can</p> <p>11 be recycled.</p> <p>12 Q And that's labeled 34 in</p> <p>13 Figure 1; correct?</p> <p>14 A Yes. Condenser.</p> <p>15 Q Do you have an opinion</p> <p>16 regarding whether Hanisch performs drying</p> <p>17 during comminution?</p> <p>18 MR. SCHENKER: Objection,</p> <p>19 vague, outside the scope.</p> <p>20 A I don't have an opinion on</p> <p>21 that. I don't think I opined on it. It</p> <p>22 is likely that during the comminution</p> <p>23 that you would be generating some gases,</p> <p>24 and maybe you would have -- you could</p> <p>25 recover some solvents then. And that</p>                             |

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| <p style="text-align: right;">Page 170</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 might be done through the other condenser</p> <p>3 that they have in here labeled as No. 20.</p> <p>4 Q So you think it's possible</p> <p>5 that Hanisch could be drawing during the</p> <p>6 comminution stage?</p> <p>7 A You've created a material</p> <p>8 with a lot of surface areas. So there'd</p> <p>9 be a lot of opportunity for evaporation,</p> <p>10 yeah. So they would probably see some of</p> <p>11 the solvents coming off at that point,</p> <p>12 probably. It's just my understanding of,</p> <p>13 you know, you've got a solid battery, now</p> <p>14 you ground it up, you have a lot of</p> <p>15 surface areas to your materials. And</p> <p>16 some of them are wet.</p> <p>17 So some stuff's going to</p> <p>18 evaporate and probably be caught in the</p> <p>19 Condenser 20. So there's a condenser</p> <p>20 here, condenser here, condenser after</p> <p>21 comminution and a condenser after</p> <p>22 pre-dry.</p> <p>23 Q In your opinion, if material</p> <p>24 was described as dry, does that</p> <p>25 necessarily mean all of the volatile</p> | <p style="text-align: right;">Page 172</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 Q So in your opinion, has the</p> <p>3 material in Hanisch been dried</p> <p>4 sufficiently long that it's been</p> <p>5 inactivated?</p> <p>6 A Well, Hanisch says that it</p> <p>7 dries something to an extent that it has</p> <p>8 been inactivated. Now, there's a couple</p> <p>9 of components there. There's the</p> <p>10 temperature, which they've decided is</p> <p>11 80 degrees or less, and the time. If</p> <p>12 they noticed they have dry material</p> <p>13 coming out, then they say, okay, my</p> <p>14 conveyor belt is going at the right</p> <p>15 speed. If stuff's coming through moist</p> <p>16 or wet or clumpy, then maybe stuff's</p> <p>17 going through the pre-dryer too fast.</p> <p>18 And they would have to slow the conveyor</p> <p>19 belt down, leave a longer residence time</p> <p>20 in the pre-dryer.</p> <p>21 But they have ways of</p> <p>22 characterizing the material as dry. One</p> <p>23 of the things that I've seen was they</p> <p>24 were measuring the -- what was it? -- the</p> <p>25 volatile organics -- the percentage of</p> |
| <p style="text-align: right;">Page 171</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 electrolyte solvents, i.e., the bulk</p> <p>3 liquid components of the electrolytes,</p> <p>4 has been removed?</p> <p>5 MR. SCHENKER: Objection,</p> <p>6 vague, lacks foundation.</p> <p>7 A Glad you used the word,</p> <p>8 liquid. Yes. All of the bulk liquid</p> <p>9 would be removed. Again, you might still</p> <p>10 have some solvent molecules that adsorbed</p> <p>11 on to a surface. But that's almost like</p> <p>12 another phase. Liquid, for it to be dry,</p> <p>13 the liquid has to leave.</p> <p>14 It's okay for you to say</p> <p>15 you're done.</p> <p>16 Q I'm getting close. I'm</p> <p>17 thinking about it.</p> <p>18 A Okay.</p> <p>19 Q So if all of the liquid has</p> <p>20 been removed, would that also mean that</p> <p>21 all of the volatile electrolyte solvents</p> <p>22 had been removed?</p> <p>23 A All of the volatile, yeah,</p> <p>24 minus the adsorbed stuff. But, yeah, all</p> <p>25 of the volatile liquid has been removed.</p>                                                                                                   | <p style="text-align: right;">Page 173</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 volatile organics in the pre-dryer</p> <p>3 chamber; in other words, have we got it</p> <p>4 down until there's less than three or</p> <p>5 preferably two or one and a half percent</p> <p>6 of volatile organics left. So they do</p> <p>7 have some metrics for deciding that</p> <p>8 things are dry. But they've evaporated</p> <p>9 off all the liquid, essentially.</p> <p>10 Q Let me direct you to</p> <p>11 paragraph 14 of your declaration.</p> <p>12 A Yes, sir.</p> <p>13 Q On the very last line of</p> <p>14 this, you say, "Methods for processing</p> <p>15 dry electrochemically inactive</p> <p>16 materials."</p> <p>17 Does dry and</p> <p>18 electrochemically inactive mean the same</p> <p>19 thing to you or different things?</p> <p>20 A In this context, they mean</p> <p>21 the same thing. If the material is dry,</p> <p>22 even if it's got the LiPF6 salt on it,</p> <p>23 there's no way for the ions -- the</p> <p>24 lithium-ions to move about because</p> <p>25 there's no solvent there to carry.</p>                                                  |

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| <p style="text-align: right;">Page 174</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 There's no liquid solvent there to carry</p> <p>3 the ions back and forth. So it's</p> <p>4 electrochemically inactive. If you've</p> <p>5 got this to a dryness like that, no</p> <p>6 electric chemical reaction can occur</p> <p>7 because no ion movement can occur.</p> <p>8 Does that answer your</p> <p>9 question?</p> <p>10 Q I think so.</p> <p>11 To a similar point, I want</p> <p>12 to direct you to the next paragraph here.</p> <p>13 You used the phrase, "Fully</p> <p>14 dried to the point of inactivation," and</p> <p>15 "fully dry with no liquid electrolyte."</p> <p>16 You used the first phrase in</p> <p>17 the third line and that second phrase in</p> <p>18 the last line. Let me know when you're</p> <p>19 caught up with me.</p> <p>20 A I'm caught up with you.</p> <p>21 Q Do these phrases mean the</p> <p>22 same thing to you?</p> <p>23 A Yes.</p> <p>24 Q And why is that?</p> <p>25 A Well, in the case of fully</p>                                                                                      | <p style="text-align: right;">Page 176</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 No. 4.</p> <p>3 (A short recess was taken.)</p> <p>4 THE VIDEOGRAPHER: On the</p> <p>5 record at 16:04, beginning Media Unit</p> <p>6 No. 5.</p> <p>7 Q Welcome back, Dr. van</p> <p>8 Schalkwijk. I only have a couple of more</p> <p>9 questions for you.</p> <p>10 The first one is, as with</p> <p>11 the other breaks, have you discussed the</p> <p>12 content of your testimony at all during</p> <p>13 the break?</p> <p>14 A No. I was alone in the</p> <p>15 bathroom.</p> <p>16 Q We discussed a little bit</p> <p>17 earlier in the day, the potential for</p> <p>18 oxidization of copper and the</p> <p>19 decomposition of copper. Do you remember</p> <p>20 that discussion?</p> <p>21 A Yes.</p> <p>22 Q Is it possible to completely</p> <p>23 prevent copper oxidization?</p> <p>24 MR. SCHENKER: Objection,</p> <p>25 vague.</p> |
| <p style="text-align: right;">Page 175</p> <p>1 DR. WALTER VAN SCHALKWIJK</p> <p>2 dried to the point of inactivation,</p> <p>3 there's no liquid electrolyte to carry</p> <p>4 the ions around in an electrochemical</p> <p>5 reaction. So that's inactive.</p> <p>6 But at the end where it says</p> <p>7 "dry cell fragments are properly</p> <p>8 understood as fully dry with no liquid</p> <p>9 electrolyte," so, in other words, those</p> <p>10 are also described as fully dry. There's</p> <p>11 no liquid. And again, there's no liquid</p> <p>12 to carry ion movement. So it's inactive.</p> <p>13 You have a furrowed brow.</p> <p>14 Q I do that sometimes.</p> <p>15 Whether it's indicative of anything or</p> <p>16 not, is the question.</p> <p>17 MR. WALLER: Maybe a quick</p> <p>18 ten-minute break. I'm through at</p> <p>19 least the planned portion of this.</p> <p>20 I'll look through a few things. And</p> <p>21 I may wrap up after that. Let's</p> <p>22 adjourn for ten minutes and see where</p> <p>23 we are.</p> <p>24 THE VIDEOGRAPHER: Off the</p> <p>25 record at 15:57, ending Media Unit</p> | <p style="text-align: right;">Page 177</p> <p>1</p> <p>2 A No.</p> <p>3 MR. WALLER: That's all I</p> <p>4 have.</p> <p>5 THE VIDEOGRAPHER: Anything,</p> <p>6 counsel?</p> <p>7 MR. SCHENKER: No re-direct.</p> <p>8 THE VIDEOGRAPHER: This</p> <p>9 concludes today's testimony given by</p> <p>10 Walter van Schalkwijk as stipulated</p> <p>11 by all parties. The total number of</p> <p>12 media units used was five and will be</p> <p>13 retained by Veritext Legal Solutions.</p> <p>14 Off the record at 16:05.</p> <p>15 (Time noted: 4:05 p.m.)</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>                                                                                                                                                                                                                                                                      |

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| <p style="text-align: right;">Page 178</p> <p>1</p> <p>2 INDEX</p> <p>3</p> <p>4 EXAMINATION</p> <p>5 EXAMINATION</p> <p>6 Mr. Waller 5</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p style="text-align: right;">Page 180</p> <p>1 Veritext Legal Solutions</p> <p>2 1100 Superior Ave</p> <p>3 Suite 1820</p> <p>4 Cleveland, Ohio 44114</p> <p>5 Phone: 216-523-1313</p> <p>6 June 13, 2025</p> <p>7 To: JOSEF B. SCHENKER, ESQ.</p> <p>8 Case Name: Ascend Elements, Inc. v. Duesenfeld GMBH</p> <p>9 Veritext Reference Number: 7405212</p> <p>10 Witness: Dr. Walter van Schalkwijk Deposition Date: 6/6/2025</p> <p>11 Dear Sir/Madam:</p> <p>12 Enclosed please find a deposition transcript. Please have the witness</p> <p>13 review the transcript and note any changes or corrections on the</p> <p>14 included errata sheet, indicating the page, line number, change, and</p> <p>15 the reason for the change. Have the witness' signature notarized and</p> <p>16 forward the completed page(s) back to us at the Production address</p> <p>17 shown</p> <p>18 above, or email to production-midwest@veritext.com.</p> <p>19 If the errata is not returned within thirty days of your receipt of</p> <p>20 this letter, the reading and signing will be deemed waived.</p> <p>21 Sincerely,</p> <p>22 Production Department</p> <p>23</p> <p>24</p> <p>25 NO NOTARY REQUIRED IN CA</p>                                                  |
| <p style="text-align: right;">Page 179</p> <p>1</p> <p>2 CERTIFICATION</p> <p>3</p> <p>4</p> <p>5 I, ANTHONY GIARRO, a Shorthand Reporter</p> <p>6 and a Notary Public, do hereby certify that</p> <p>7 the foregoing witness, DR. WALTER VAN</p> <p>8 SCHALKWIJK, was duly sworn on the date</p> <p>9 indicated, and that the foregoing, to the</p> <p>10 best of my ability, is a true and accurate</p> <p>11 transcription of my stenographic notes.</p> <p>12 I further certify that I am not</p> <p>13 employed by nor related to any party to this</p> <p>14 action.</p> <p>15</p> <p>16 </p> <p>17</p> <p>18 ANTHONY GIARRO</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p> | <p style="text-align: right;">Page 181</p> <p>1 DEPOSITION REVIEW</p> <p>2 CERTIFICATION OF WITNESS</p> <p>3 ASSIGNMENT REFERENCE NO: 7405212</p> <p>4 CASE NAME: Ascend Elements, Inc. v. Duesenfeld GMBH</p> <p>5 DATE OF DEPOSITION: 6/6/2025</p> <p>6 WITNESS' NAME: Dr. Walter van Schalkwijk</p> <p>7 In accordance with the Rules of Civil</p> <p>8 Procedure, I have read the entire transcript of</p> <p>9 my testimony or it has been read to me.</p> <p>10 I have made no changes to the testimony</p> <p>11 as transcribed by the court reporter.</p> <p>12</p> <p>13 Date Dr. Walter van Schalkwijk</p> <p>14 Sworn to and subscribed before me, a</p> <p>15 Notary Public in and for the State and County,</p> <p>16 the referenced witness did personally appear</p> <p>17 and acknowledge that:</p> <p>18 They have read the transcript;</p> <p>19 They signed the foregoing Sworn</p> <p>20 Statement; and</p> <p>21 Their execution of this Statement is of</p> <p>22 their free act and deed.</p> <p>23</p> <p>24 I have affixed my name and official seal</p> <p>25 this ____ day of _____, 20____.</p> <p>_____<br/>Notary Public</p> <p>_____<br/>Commission Expiration Date</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p> |

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| <div>1           DEPOSITION REVIEW</div> <div>2           CERTIFICATION OF WITNESS</div> <div>3           ASSIGNMENT REFERENCE NO: 7405212</div> <div>4           CASE NAME: Ascend Elements, Inc. v. Duesenfeld GMBH</div> <div>5           DATE OF DEPOSITION: 6/6/2025</div> <div>6           WITNESS' NAME: Dr. Walter van Schalkwijk</div> <div>7           In accordance with the Rules of Civil</div> <div>8           Procedure, I have read the entire transcript of</div> <div>9           my testimony or it has been read to me.</div> <div>10          I have listed my changes on the attached</div> <div>11          Errata Sheet, listing page and line numbers as</div> <div>12          well as the reason(s) for the change(s).</div> <div>13          I request that these changes be entered</div> <div>14          as part of the record of my testimony.</div> <div>15          I have executed the Errata Sheet, as well</div> <div>16          as this Certificate, and request and authorize</div> <div>17          that both be appended to the transcript of my</div> <div>18          testimony and be incorporated therein.</div> <div>19          _____</div> <div>20          Date                 Dr. Walter van Schalkwijk</div> <div>21          Sworn to and subscribed before me, a</div> <div>22          Notary Public in and for the State and County,</div> <div>23          the referenced witness did personally appear</div> <div>24          and acknowledge that:</div> <div>25          They have read the transcript;</div> <div>26          They have listed all of their corrections</div> <div>27          in the appended Errata Sheet;</div> <div>28          They signed the foregoing Sworn</div> <div>29          Statement; and</div> <div>30          Their execution of this Statement is of</div> <div>31          their free act and deed.</div> <div>32          I have affixed my name and official seal</div> <div>33          this _____ day of _____, 20____.</div> <div>34          _____</div> <div>35          Notary Public</div> <div>36          _____</div> <div>37          Commission Expiration Date</div> | Page 182 |  |
| <div>1                 ERRATA SHEET</div> <div>2                 VERITEXT LEGAL SOLUTIONS MIDWEST</div> <div>3                 ASSIGNMENT NO: 7405212</div> <div>4                 PAGE/LINE(S) /     CHANGE     /REASON</div> <div>5                 _____</div> <div>6                 _____</div> <div>7                 _____</div> <div>8                 _____</div> <div>9                 _____</div> <div>10                _____</div> <div>11                _____</div> <div>12                _____</div> <div>13                _____</div> <div>14                _____</div> <div>15                _____</div> <div>16                _____</div> <div>17                _____</div> <div>18                _____</div> <div>19                _____</div> <div>20                _____</div> <div>21                Date                 Dr. Walter van Schalkwijk</div> <div>22                SUBSCRIBED AND SWORN TO BEFORE ME THIS _____</div> <div>23                DAY OF _____, 20____.</div> <div>24                _____</div> <div>25                Notary Public</div> <div>26                _____</div> <div>27                Commission Expiration Date</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Page 183 |  |

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

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