

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4
5 SYMRISE AG and SYMRISE INC.,

6 Petitioners,

7 v.

8 INOLEX INVESTMENT CORP.,

9 Patent Owner.

10
11 Case IPR2023-01035

12 U.S. Patent No. 10,995,048

13
14 Deposition of MICHAEL E. WRIGHT, Ph.D.

15 Tuesday, April 23, 2024

16 9:33 a.m.

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18
19
20 Job No.: 534429

21 Pages: 1 - 165

22 Reported By: Dawn M. Hart, RPR/RMR/CRR

1 Deposition of Michael E. Wright, Ph.D., held
2 at the law offices of:

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19 Pursuant to Notice, before Dawn M. Hart,
20 RPR/RMR/CRR and Notary Public and Brad Sydorick,
21 Notary Public for the Commonwealth of
22 Pennsylvania.

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A P P E A R A N C E S

ON BEHALF OF THE PETITIONERS:

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C O N T E N T S

EXAMINATION OF MICHAEL E. WRIGHT, Ph.D.	PAGE
By Mr. Murphy	5

E X H I B I T S

(Exhibit attached to the transcript.)

M. WRIGHT DEPOSITION EXHIBIT	PAGE
Exhibit 1039 WO 2015/130451 A1	104

1 P R O C E E D I N G S

2 MICHAEL E. WRIGHT, Ph.D.

3 being first duly sworn or affirmed to
4 testify to the truth, the whole truth, and nothing
5 but the truth, was examined and testified as
6 follows:

7 MR. MURPHY: All right. Good morning.
8 We're here for the deposition of Dr. Michael
9 Wright in IPR 2023-01035 regarding Patent
10 10,995,048.

11 I'm Ryan Murphy. I represent the
12 Petitioner, Symrise. You want to --

13 MR. LUKAS: I'm Aaron Lukas of the law
14 firm Cozen O'Connor, Washington, DC. I'm here on
15 behalf of the Patent Owner, Inolex Investment
16 Corp., and the witness.

17 MR. MURPHY: All right.

18 EXAMINATION BY COUNSEL FOR THE PETITIONER SYMRISE
19 BY MR. MURPHY:

20 Q Good morning, Dr. Wright. Can you
21 introduce yourself for the record?

22 A My name is Michael E. Wright. And E is

1 Eugene.

2 Q Have you ever had your deposition taken
3 before?

4 A Yes, I have, approximately twenty-some
5 years ago.

6 Q So it's been a little while?

7 A Yeah. Yeah.

8 Q Well, we'll just walk through a couple
9 of the basics.

10 I'll ask questions and, you know, you'll
11 give your answers. They're under oath. Your
12 testimony here has as much force as if you were
13 giving it directly before a judge.

14 If your attorney objects to any of the
15 questions, you should still respond unless he
16 instructs you not to.

17 If you don't understand any of the
18 questions, just ask, and we can rephrase or repeat
19 so you can understand them.

20 And if you need a break at any time,
21 just let me know. If there's a question pending
22 or maybe a couple of questions, we might wait a

1 minute to take it, but we'll get you a break as
2 you need it.

3 Is that all right?

4 A Sounds good.

5 Q Perfect.

6 Is there anything today that would
7 prevent you from providing full and complete, true
8 answers in your testimony?

9 A No.

10 Q You haven't taken any medication or
11 there's no health conditions that would prevent
12 you from testifying truthfully?

13 A No.

14 Q And you understand that we're here to
15 discuss your Declaration that you submitted in IPR
16 proceeding 2023-01035 related to U.S. Patent No.
17 10,995,048?

18 A Yes.

19 Q Who contacted you to be retained in this
20 matter?

21 A Aaron.

22 Q Can you let us know all the people

1 you've worked with in preparation of your
2 Declaration?

3 A Aaron and I met, and we have worked on
4 the draft documents coming up to the final
5 document which you received.

6 Q Did you talk with anyone that -- other
7 than the attorneys here at Cozen in preparation of
8 your Declaration?

9 A No.

10 Q Did you prepare for your deposition
11 today?

12 A Yes, I did.

13 Q And what materials did you review?

14 A I reviewed, of course, my deposition,
15 Dr. Tabor's deposition, and of course reviewed his
16 report. I'm calling it a report. I'm not sure of
17 the number on it. I'm referring to his report.
18 And of course the documents that were listed in
19 the reports. I can't just rattle those off,
20 unfortunately, by number. We've gone through
21 these -- you know, there's thousand 1, thousand 2,
22 thousand 3. But I've reviewed documents that were

1 listed and pertinent --

2 Q Okay.

3 A -- that I could.

4 Q And just to clarify real quick, you said
5 you reviewed your deposition. I'm assuming you
6 mean your Declaration for today?

7 A Declaration, excuse me. That's --
8 chemist's mistake.

9 Q Did you review the Institution Decision
10 that the Board provided?

11 A No.

12 Q And who did you meet with to prepare for
13 the deposition today?

14 A Just Lukas.

15 Q And about how long did you prepare?

16 A Oh, I think we probably spent two to
17 three hours discussing, we -- our getting to know
18 each other and talking about family here and
19 there. So it wasn't all strictly deposition prep.
20 It was getting to know each other a little bit.
21 So I would say two to three hours max.

22 Q I'm going to hand you what's been

1 previously marked Inolex Exhibit 2001.

2 Do you recognize this document?

3 A Yes, I do.

4 Q And can you turn to the final page of
5 your Declaration, page 35. Is that your
6 signature?

7 A Yes, it is.

8 Q And when you signed the Declaration, you
9 understood and agreed that you were giving this
10 Declaration under penalty of perjury and that all
11 the statements were true?

12 A Yes.

13 Q And after reviewing your Declaration,
14 preparing for today, are there any changes you
15 want to make, or did you notice any errors or
16 anything that you want to correct?

17 A There's only one word I think that I
18 thought -- paragraph 1. So I had been retained by
19 Patent Owner, and I wanted to clarify that that's
20 probably been, I have been engaged by or --
21 because "retained" might imply money or a
22 contract, and that's not the case.

1 So I think "retained" in legal terms
2 might have a false meaning, so I wanted to make
3 sure that was clear.

4 That was, that would be the only sort of
5 word change I would make. I thought maybe it
6 was -- not that it's wrong, but it may be not the
7 best word.

8 Q And did you write that Declaration
9 yourself?

10 A Yes. I wrote, of course, with the help
11 of legal, Aaron. Some of it is a bit more
12 legalese and I need help in how that's best
13 stated. And I --

14 So I will say when it comes to the
15 chemistry, the facts, the science, and
16 understanding the science, and understanding the
17 invention, it's 100 percent me. Getting guidance
18 in the legal aspects, I certainly confided in the
19 attorney.

20 Q And if we turn to paragraph 9 of your
21 Declaration -- and we'll just kind of get this out
22 of the way -- you mentioned you have no financial

1 interest in the outcome of this proceeding. So
2 you're not being compensated in any way; is that
3 correct?

4 A Correct.

5 Q And do you have any financial stake in
6 the outcome of this proceeding?

7 A I can say absolutely not, that my
8 initial consulting contract had no stipulation
9 about royalty rights or things like that. It's --
10 I'm here solely because I believe in the work and
11 I believe it's -- the right thing is to keep the
12 patent with the amendments that have been
13 suggested by Legal. But I am here. I will not
14 have one more dollar in my bank account today or
15 10 years from now as a result of this action.

16 Q And what's your current employment
17 status?

18 A Well, I run a company,
19 BioWright Technology. We have a website and we
20 are a consulting, but we also are actively seeking
21 capital investment. And I work with the ASTM in
22 fuel development for molecules and fuels made for

1 biomolecules, bioalcohol.

2 So I continue to do that quite actively.

3 Is that making me a lot of money, no, but I do
4 have consulting contracts that come in once in a
5 while with companies and -- not Inolex, but
6 different companies I work with.

7 Q So I mean just to be clear, then, yes,
8 you have no current or future consulting contracts
9 with Inolex at this time?

10 A Yeah, we do not have any. So it's --
11 there's no payout coming if we win and we'll give
12 you this contract, absolutely not.

13 Q And can we turn to paragraph 11 now. We
14 briefly touched on this, but this is a list of the
15 materials you reviewed. So I just wanted to
16 doublecheck that this is a list of -- you have
17 that first paragraph that kind of lists the
18 exhibits from the Petitioner's side that you
19 reviewed, then you have the materials reviewed
20 that were provided by Inolex; is that correct?

21 A Yes.

22 Just wanted to make sure the

1 deposition -- as I already confused Declaration
2 and deposition, I wanted to make sure I looked at
3 both documents for Dr. Tabor's, so ...

4 Q Are there any materials that you know of
5 that might be relevant that you haven't listed
6 here?

7 A No, no. I felt I reviewed what needed
8 to be done for this deposition, so ...

9 Q Did you review any materials that
10 weren't provided by the Petitioner or the Patent
11 Owner in this case?

12 A Did I -- it's a little difficult
13 question to ask. I mean --

14 Q Let me rephrase. Strike that, I'll
15 rephrase.

16 A Okay.

17 Q Are there any other materials that would
18 be relevant that you know of that are relevant to
19 the substitute claims that you know of that you
20 reviewed for this deposition?

21 A I can absolutely say no on that phrased
22 in that way. Thank you for rephrasing it.

1 Q We're going to start -- can we look at
2 paragraph 54 of your Declaration?

3 A Absolutely.

4 Q That's where we talk about -- or where
5 you quote the substitute claim 29. If you let me
6 know when you're there.

7 A Okay, I am there.

8 Q So I'm just going to kind of walk
9 through this substitute claim and get your
10 understanding of what the terms mean.

11 So the first clause in this claim is
12 dehydrating of bio-1-alcohol by heating the
13 bio-1-alcohol in a reactor.

14 Do you see that clause?

15 A Uh-humh.

16 Q What would "heating" mean in this
17 context?

18 A "Heating" would refer to heating the
19 reactor which contains a catalyst. It would be
20 implied that there was a catalyst, or something in
21 a reactor, that was capable of transforming the
22 bio alcohol to a product.

1 Q Would you be heating the bio-1-alcohol
2 in the reactor?

3 A When you do solid-state reactions -- and
4 this is where it's a little different -- then you
5 don't mix everything in the pot and then turn the
6 heat on. In solid-state reactors, the heat is
7 turned on the reactor with nothing in the reactor
8 other than the catalyst. Then the reactor is
9 introduced into the heated vessel.

10 So it's -- it would be inappropriate to
11 say that they are put together and then heated, so
12 I think that's a distinction.

13 So I think, you know, you would normally
14 heat the reactor first, but you are in fact
15 heating a reactor and an alcohol, but I just
16 wanted to clarify that the reactor is heated often
17 before.

18 Q And then would -- so in that process you
19 just described, would the alcohol be heated prior
20 to entry, or would you put it in at like an
21 ambient temperature and then it would heat up as
22 it goes through the reactor?

1 A You're correct in both statements. It
2 can be heated before or it can go into the reactor
3 room temperature.

4 Q What is the impact of introducing the
5 alcohol at room temperature with respect to the
6 dehydration reaction?

7 A It could have a consequence of lowering
8 how much alcohol you could put into the reactor
9 per hour or per minute. So there's -- could be a
10 small consequence of throughput through the
11 reactor, and it can be small. It could be
12 significant. Often it's small.

13 Q We'll talk about this part of the claim
14 in a second, but just to clear it up while we're
15 talking about this, would the introduction of an
16 ambient temperature bio-1-alcohol have any impact
17 on the conversion of the reaction, the dehydration
18 reaction?

19 A I have to answer that with a yes and no.
20 I mean the answer is yes, if you were
21 trying to push too much alcohol through and it
22 didn't have sufficient time in the reactor to

1 react at the temperature that you needed, you
2 could hurt the conversion, or diminish the
3 conversion.

4 The other option is you can slow the
5 feed into the reactor at room temperature and your
6 conversion would be 98, 99 percent.

7 So it's -- I suspect we'll talk about
8 that sometime in the deposition, but it's -- when
9 you talk about reactors like are spoken to in this
10 patent, you really have a feed rate and a
11 temperature of the reactor, and those are two
12 dynamics that control conversion, to a large
13 degree, for a specific catalyst that is in
14 question.

15 Q The next phrase in the claim discusses
16 a --

17 (Court Reporter clarification.)

18 MR. MURPHY: I'll start over.

19 Q So the next phrase in the claim states:

20 A base treated and calcined gamma
21 alumina catalyst. Do you see that part?

22 A Correct, yes.

1 Q What would "base treated" mean in this
2 context?

3 A It's referring to what would be commonly
4 known as a Bronsted base. So it could be various
5 alkaline metals, it could be transition metals,
6 but it would be a compound that is, or could
7 become, a base.

8 Q And then for the calcined, what would
9 that mean? What would a person of skill in the
10 art consider "calcined" to mean in the context of
11 claim 29?

12 A Calcined is a heating process that
13 induces chemical change in the catalyst support.

14 Q Is there a specific temperature range
15 that a person of skill in the art would understand
16 calcining takes place at?

17 A Oh, I think calcining -- you could look
18 at it as a range. I think a POSITA might say
19 between 200 and 600 degrees centigrade.

20 Q And then the phrase says, a base treated
21 and calcined gamma catalyst.

22 Do you understand that to be a specific

1 order that's necessary in the claim?

2 A Yes.

3 Q So the claim requires it to be, the
4 catalyst to be base-treated and then calcined?

5 A Correct.

6 Q If you calcined it and then base-treated
7 the catalyst, if you flip the order that we just
8 described, what would the consequences on the
9 dehydration reaction be?

10 A That's a good question. I don't know.

11 Q Is there any consequence to avoiding a
12 calcination step after treating a gamma alumina
13 catalyst with a base?

14 A Well, the consequence would be you have
15 not incurred, or created, the chemical change and
16 you've merely absorbed the base onto your
17 catalyst, which is different than absorbing the
18 base or absorbing the compound and calcining.
19 There's a distinct chemical difference between
20 those two species.

21 Please don't be afraid to ask me to say
22 that in a different way. Sometimes I can explain

1 things differently. I'm more than happy to re --

2 Q I'm just trying to lay the groundwork
3 for, you know, as we walk through these things,
4 you know, what you're meaning by "calcining," so
5 when I say --

6 A Absolutely.

7 Q -- hey, this is calcined, we're kind of
8 speaking the same language.

9 A Absolutely. Great.

10 Q The next phrase says, wherein the
11 catalyst has not been silanization.

12 What does that mean to a person of skill
13 in the art?

14 A Well, silanization -- and that's
15 A-T-I-O-N at the end, so -- would imply treating a
16 surface with a silicon, silicon-containing
17 precursor, and that silicon would be modified onto
18 the surface, and you would call that a silanized
19 surface.

20 You know, sort of a commercial example
21 that you would be familiar with would be when you
22 put anti-fogging compounds on goggles and things

1 like that, you're actually silanizing the surface
2 of the glass in a way that it makes it hydrophobic
3 and fog doesn't adhere to the glass. So you would
4 argue that that glass has been silanized to ...

5 What I think you have to be careful of,
6 and what I'm giving you is an example of where
7 that silane is absorbed onto the surface. It's
8 not calcined or chemically modified onto the
9 surface. And that's, again, to kind of get you
10 familiar with calcine versus just chemically
11 absorbed.

12 You know, calcine implies if you did
13 that, the protectant for the glass would actually
14 be modified on that surface and it's there for a
15 long, long time. It essentially can't be wiped
16 off. It's chemically part of the structure.

17 Q Does this clause imply like an
18 intentionality, like a -- does the person of skill
19 in the art have to add a substance to the catalyst
20 for this to be not silanized?

21 A No.

22 Q So if there's just impurities in the

1 catalyst, it would still be considered silanized,
2 for example?

3 A No. That's a very broad conclusion to
4 say, you know, if we didn't add anything, it's
5 silanized. That's -- one can't say that. I think
6 that's what you were --

7 Q Yeah, I think I was asking slightly -- I
8 was asking if there's just impurities in the
9 catalyst, like I buy a catalyst, there's
10 impurities there, could that be -- would a person
11 of skill in the art consider that to be silanized
12 with respect to claim 29?

13 A I think the simple answer to say is no.

14 Q No. How would a person of skill in the
15 art know that the catalyst has been silanized?

16 A You would see it in the preparation of
17 the catalyst. It would be a specific step. And I
18 can make reference to, you know, my original
19 patent from the Navy in 2010-ish or '12-ish,
20 whenever it issued. You know, there was a
21 specific step to silanize the catalyst, so it was
22 part of the spec and, of course, part of the

1 claims, so you would see it as a discrete visible
2 step.

3 Q Okay. Going to the next clause:

4 Wherein the resulting bioalkene has a
5 carbon chain of 6, 2, 14 carbon atoms, and it's
6 produced in a conversion of at least 95 percent.

7 A Okay.

8 Q So is this saying that 95 percent of the
9 bio-1-alcohol is converted to an alkene? Is that
10 what "95 percent conversion" refers to?

11 A No, that doesn't say that. It just says
12 95 percent of the alcohol is no longer alcohol.
13 That's been converted to something else.

14 Q So as long as 95 percent of the alcohol
15 undergoes a reaction to a different product, then
16 it's been converted?

17 A Correct.

18 Q Then finally, we have a bio-1-alkene
19 with selectivity of 92 to 99 percent.

20 And is that just saying that of the
21 bioalkenes that are produced in a reaction, 92 to
22 99 percent are the 1-alkene?

1 A Correct.

2 Q Can we turn back to paragraph 17. I
3 just wanted to talk to you about the final
4 sentence of that paragraph where it says:

5 Further, the purity of the alcohol
6 feedstock largely controls the purity of the
7 resulting alpha-olefin, regardless of catalyst.

8 A Okay.

9 Q Does this mean that if you've purified
10 the alcohol going into the reaction, that you can
11 control the 1-alkene coming out of the reaction?

12 A No.

13 Q What does "largely controls the purity
14 of the resulting alpha-olefin" mean to you?

15 A The feedstock can contain molecules or
16 things that deactivate or change the catalyst, and
17 so your input into a reactor needs to be
18 controlled in a reaction like this.

19 Q Okay. So this is more saying that if
20 you foul the catalyst, it impacts the purity of
21 the resulting, of the results of the reaction?

22 A Exactly.

1 Q Okay. Then we will next look at
2 paragraph 18.

3 A Okay.

4 Q I was looking at the final sentence that
5 breaks from page 8 to page 9 where it says:

6 Lawson heterogenous catalyst
7 regioselectivity in general has been attributed to
8 1-alkene isomerization by strong Lewis and/or
9 Bronsted acid sites.

10 A Okay.

11 Q Are there any processes known to a
12 person of skill in the art to reduce the strong
13 Lewis and/or Bronsted acid sites in a gamma
14 alumina catalyst?

15 A Yes.

16 Q What would some of those processes be?

17 A One would be treatment with a base or
18 base precursor and calcination.

19 Q And then if a person of skill in the art
20 wanted to then reduce the isomerization of the
21 reaction, they would know that you could calcine
22 the catalyst or treat it with a base?

1 A According to my 2010 patent or '12
2 patent -- I should give you the number here -- but
3 the original patent where we dehydrated 1-butanol,
4 that was working on the premise that bases tend to
5 decrease -- base treatment of the catalyst tends
6 to decrease isomerization.

7 Q And then I believe you said also that
8 the calcination would reduce the isomerization?

9 A The calcination is required to
10 incorporate the base into the structure, and
11 actually lead to the deactivation. It's not
12 simple just base treatment. You need to be -- it
13 needs to be followed by a calcination step to
14 integrate it into the structure. Otherwise, it
15 would potentially be washed out in a matter of an
16 hour. It could --

17 (Interruption.)

18 MR. MURPHY: Back on.

19 BY MR. MURPHY:

20 Q So we were just talking, before the
21 interruption, about the calcination and how it may
22 or may not impact isomerization.

1 So just to close that loop, would
2 calcination of a gamma alumina catalyst on its own
3 have any impact on the isomerization during
4 alcohol dehydration?

5 A I'll say no, with a reference that that
6 implies it wasn't treated with anything prior to.
7 You're talking about taking a gamma alumina
8 catalyst that you purchased from Evonik or
9 Clariant and you put it into a calcination vessel
10 and heated it to four or 500 degrees centigrade,
11 it would remain unchanged.

12 Q We'll just clarify. The isomerization
13 would remain unchanged?

14 A No, the catalyst would remain unchanged.

15 Q It wouldn't change the catalyst at all?

16 A Yeah, I thought you were talking about
17 treatment of a catalyst with calcination without
18 any pretreatment would give you the same catalyst
19 that you started with. And --

20 Q That was what I was clarifying. I just
21 wanted to clarify if you meant just with
22 isomerization --

1 A Yeah.

2 Q -- or the catalyst itself?

3 A The catalyst itself would be the same.

4 Q So --

5 A Exactly.

6 Q So then I guess you have to heat the
7 catalyst above 400 degrees for calcination to
8 begin?

9 A Well, as I mentioned, I gave a range of
10 200 to 600, and I think you have to be careful of
11 what your pretreatment was with or your -- you can
12 call it doping or treatment with a precursor that
13 it's going to be calcined in, and not every
14 reaction -- for instance, just using gamma
15 alumina, but depending on what your support is,
16 occurs at 400 degrees or 500 degrees. There are
17 reactions that can start occurring at 200 degrees
18 centigrade, and then there are deleterious or
19 negative reactions that occur if you go too high.

20 And I think actually Inolex's patent --
21 (Court Reporter clarification.)

22 THE WITNESS: I'm not sure where to

1 start. I'm happy to start again, I just didn't
2 want to -- didn't know where to start.

3 Q So you were saying that you think
4 actually Inolex's --

5 A Well, what I was saying was Inolex
6 demonstrated that calcination temperature can have
7 an effect on the reaction that is occurring with
8 your modification agent.

9 So when we say calcination temperature,
10 it can be critical to the invention, to the
11 catalyst. So when I gave a range of temperatures
12 for calcination, it doesn't imply everything
13 within that temperature range works for every
14 precursor for every catalyst.

15 Q Okay. So just so I can, you know,
16 clarify here, so it's your opinion that
17 calcination can take place between two and
18 600 degrees, but the impact of that calcination
19 depends on what the catalyst was pretreated with?

20 A Exactly. And the temperature required
21 is dependent upon the precursor or the dopant that
22 you added to the -- and the catalyst itself,

1 rather. It's, you know, zirconium oxide, or
2 aluminum oxide.

3 So I think it's always useful to have
4 broad ranges, but I think you have to look at
5 specific catalyst, whether it's gamma alumina or
6 this or that, and be specific.

7 Q Okay. And I guess we can just go right
8 into paragraph 19 where you kind of give some
9 examples of calcination.

10 And I guess in the middle of the page
11 you discuss: For example, aluminum hydroxides,
12 oxohydroxides, and oxides can be converted to the
13 more desired and catalytically active gamma
14 alumina by heating; (i.e., calcining) the material
15 at temperatures of 450 to 600.

16 Do you see that?

17 A Yeah.

18 Q Are you talking here about like changing
19 the, like changing from, one of the oxides to the
20 gamma alumina, like to the final catalyst, the
21 transition between that, you know, to the final
22 product? Is that what you're referring to here?

1 A This would be referring to aluminum
2 hydroxides are the precursors to making alpha
3 alumina, gamma alumina, and beta alumina, and so
4 that temperature range is typical of making the
5 gamma alumina.

6 It is not, you know, it's not referring
7 to a modification or changing from alpha to gamma
8 or gamma to alpha, which you, once you have alpha,
9 you're stuck with alpha for the most part.

10 So that's referring to the actual gamma
11 catalyst preparation, and that depends on how
12 you -- exactly which aluminum hydroxide you have
13 because there are three or four different types of
14 aluminum hydroxide that form different gamma and
15 beta and alpha aluminas, so ...

16 Q Then would you consider the transition
17 from gamma to alpha, would that be a calcination
18 process that changes it from gamma to alpha?

19 A I generally would not consider that a
20 calcination transformation. I would consider that
21 a morphology change.

22 Q So a change of morphology is not

1 considered calcination under --

2 A Calcination.

3 Q -- what you would consider calcination?

4 A Correct.

5 Q And then is there a time component
6 associated with calcination?

7 A I think when you look at calcination, it
8 needs to be long enough -- your question is what
9 is long enough, and I think depending on what
10 you're modifying with, and that could be
11 determined by weight loss, and et cetera, you can
12 determine that calcination is complete.

13 Generally speaking, people with calcine
14 between 12 and 24 hours -- I used to always joke
15 about that the reason everything was done in
16 18-hour increments is because they went home at 5
17 and they got back after coffee and started doing
18 things at 10 o'clock or 11 o'clock, so everything
19 was calcined for 18 hours.

20 Was it the exact time needed in most
21 cases? Has it been vigorously analytically
22 characterized? I think the answer, most papers

1 and patents you read, the answer is no. That's
2 generally, with somebody that's a POSITA in the
3 area would recognize that 12 to 24 hours is enough
4 time.

5 And part of that is historical
6 references. So you're using existing literature
7 to use a reaction time -- to decide what your
8 reaction time is, I should say, or calcining.

9 You note I'm saying reaction, calcining,
10 I said both simultaneously. I sort of look at
11 those as you are completing a surface modification
12 reaction in calcining.

13 Q So I guess to restate it a little bit,
14 it would be as soon as the calcination reaction is
15 complete, it's been calcined, and that could take
16 different times depending on what you are
17 calcining?

18 A Yes, it's possible. It certainly is
19 possible.

20 Q Is it temperature-dependent also? Would
21 you say it's -- like if we calcine at a higher
22 temperature, you could shorten the time?

1 A Well, it gets back to a point I made
2 specifically that you can actually -- and I think
3 the Inolex patent discloses, if you go too high,
4 that you can actually change the calcination steps
5 and the catalyst activity and selectivity.

6 So calcination -- and the time is
7 something that you could see unexpected results.
8 And, you know, is it just simply trial and error?
9 To some extent, it is, in inventing new
10 solid-state catalysts. It's very difficult to
11 take and have the analytical instruments available
12 to look at, in trying to deduce what the surface
13 is throughout the catalyst.

14 You know, you have to keep in mind that
15 these catalysts that we're talking about typically
16 in this, in this Inolex patent, I'll say, and
17 imagine a teaspoon, just a flat teaspoon of
18 catalyst as the surface area of a 100 by 100 foot
19 room at least, and that's how much surface area it
20 has. And within the pores, and the particles
21 within the pores of that catalyst. So it's,
22 there's a lot of surface area undergoing

1 reactions, and it's very difficult to look inside
2 pores using spectroscopy.

3 So it's one of the reasons catalysts are
4 often developed by you put them together and you
5 run them and you look for sort of expected
6 results. And then you get that occasional
7 unexpected result that you've invented something
8 unique.

9 Q Okay. If we turn to paragraph 21. Here
10 you're starting to discuss the '048 patent itself,
11 and in this first sentence of paragraph 21 you
12 say:

13 Dehydration reactions conducted using a
14 gamma alumina catalyst that is first treated with
15 a promoter and then calcined.

16 A Correct.

17 Q Before when we talked about this, we
18 were talking about bases, and now the language is
19 changed to a promoter.

20 Can you just explain what you consider
21 to be the difference between those two things?

22 A Well, I would say depending on your

1 reaction, a base may not be a promoter, may not
2 facilitate the reaction chemistry.

3 So I think in the case of alcohol
4 dehydration, we're using promoter and base
5 interchangeably. I am in this deposition. I
6 could have used first treated with a base,
7 precursor or base.

8 And I need to make it specific where I
9 say base precursor. You don't always have to add
10 a base, but after calcination, you would expect it
11 to become a basic site.

12 Q So I guess to pick up a little bit on
13 what you just said, for dehydration reactions, are
14 all bases promoters?

15 A No, I wouldn't -- I certainly would not
16 make that statement. A, not having tested all the
17 bases that are out there, and B, I'm not aware of
18 a literature article or paper that, in my
19 experience that said all bases are universal
20 promoters and accelerators of dehydration.

21 And I think it's mentioned in this, and
22 I believe my deposition -- I can't go to the exact

1 page -- but dehydration, the rate of dehydration
2 is very different than the selectivity of the
3 dehydration. You can have very fast rates with no
4 selectivity.

5 And so, you know, when it says you're
6 just going to affect the rate of the dehydration,
7 you have to ask yourself, what's the end game?
8 Just to make alkene, or do you want to make a
9 specific alkene?

10 Q I guess what bases, then, would you
11 consider to work with the dehydration reaction?

12 A I think you look at the alkaline earth
13 metals, so the lithium, the sodium. But it can be
14 other more -- essentially go down the Periodic
15 Table row to row. You know, do you want to get to
16 rubidium or something or some sort of more exotic
17 heavy metal oxide? Probably not.

18 So generally you're talking about the
19 alkaline earth metal bases.

20 Q I'm going to hand you what's previously
21 been marked Exhibit 1001. This is U.S. Patent No.
22 10,995,048.

1 Do you recognize this patent?

2 A Yes, I do.

3 Q Did you review this in preparation for
4 the deposition today?

5 A Yes, I did.

6 Q And then can we turn to column 11 -- oh,
7 I'm sorry. Column 29, Example 11 is what I was
8 going to ask you.

9 So column 29, and then Example 11.

10 A Okay, I am there.

11 Q And it looks like the second-to-last
12 sentence of this paragraph, we talk about -- or
13 the patent states that:

14 For this series of dehydration reaction
15 examples, the temperature was varied from 330 to
16 370, and the feed rate was adjusted to achieve
17 between 1 and 2 percent hexanol passing through
18 the reactor.

19 Do you see that?

20 A Correct, yes.

21 Q And we mentioned this a little bit
22 earlier where you stated that the temperature and

1 the feed rate are really the, you know, two
2 primary drivers of conversion.

3 And so I guess my question is, is, at
4 each of these temperatures, would a person of
5 skill in the art just be able to alter the flow
6 rates to achieve the 98 to 99 percent conversion
7 that's referenced here?

8 A I'm not sure if your -- your question
9 is, would the operator of the catalytic reactor or
10 the inventor of the catalyst? I'm not quite sure
11 I understand the question.

12 Are you saying if you have this unique
13 good catalyst, could an operator of normal skill
14 go in and optimize that catalyst?

15 Q Yes. Could a person of skill in the art
16 who's running this dehydration reaction --

17 A Given a catalyst.

18 Q -- given --

19 A They didn't invent it, they didn't get
20 it off the shelf, they were given a unique ...

21 Could an operator, could a chemical
22 engineer come in and decide what parameters to

1 change? Yes, they would instinctively know that
2 lower conversions, you would go to a slower feed.
3 Or you potentially could raise the temperature,
4 but the consequences, the temperature raises would
5 probably decrease selectivity as you start to get
6 more conversion.

7 So keep in mind it's very
8 catalyst-dependent. You can't just go and get
9 these numbers by putting a catalyst in a reactor
10 and somebody can turn the knobs and get, you know,
11 conversions of 90-plus percent and selectivity of
12 99 percent.

13 But given a catalyst that has a certain
14 performance, could an operator go in and know or
15 potentially optimize reaction conditions? Yes.

16 Q And how would the person of skill in the
17 art know what the performance of the catalyst was?

18 A Well, they would have to test that and
19 determine after they've made the catalyst. If
20 it's -- if it -- let me just back up. I have sort
21 of lost my train of thought. I'm sorry.

22 Could you restate the question again?

1 I'm sorry, Ryan.

2 Q So the question was, how would a person
3 skilled in the art know what the performance of
4 the catalyst is?

5 A Well, if it's a new catalyst, they
6 wouldn't know what the performance was until they
7 ran the reactor and attempted, I'll use the word
8 attempted to optimize it to a certain level of
9 performance.

10 You know, you could take sand from the
11 ocean and throw it into a solid-state reactor and
12 start putting alcohol through there and probably
13 get a certain amount of dehydration to occur.
14 What level you'd achieve, probably not very
15 impressive.

16 Would an operator -- and this is why I
17 was trying to say, it's why I'm bringing up this
18 example is an operator would generally know that
19 to get the highest conversion, they would, you
20 know, and selectivity, they would try and meter
21 between feed rate and temperature and try and find
22 that, I'll call it a sweet spot.

1 And I think that would be fairly common
2 knowledge for any kind of operator, you know, in a
3 reactor system, how to design a catalyst, get a
4 catalyst. That's a different ballgame than
5 actually just optimizing a reactor.

6 So I wanted to just clarify there's a
7 big difference between optimizing a reactor and
8 designing a catalyst or finding that magical
9 catalyst that does the job.

10 Q So if you look on -- if we look at --
11 can we turn back to your Declaration?

12 A Okay.

13 Q At paragraph 21.

14 And this is where your Declaration is
15 discussing the same reaction. And we have Table 5
16 excerpted at the bottom of that paragraph.

17 A Okay.

18 Q So just, you know, to kind of follow up
19 on this point that you were just making, if a
20 person of skill in the art wanted to run this
21 reaction at 300 degrees, would they be able to
22 predict what conversion you would get, or would

1 you have to run the reaction and figure it out?

2 A Well, if I was given a catalyst that
3 somebody said, you know, I've tested and run this
4 catalyst and this is the performance, as a
5 scientist I would expect to be able to reproduce
6 that in my lab.

7 And that, of course, is part of the
8 process that is done when you commercialize a
9 catalyst, is somebody else tested and actually
10 those numbers are verified.

11 Would somebody be able to walk in and
12 say, I treated this catalyst with this promoter
13 and did this and they would automatically know
14 what the performance of that catalyst would be,
15 no.

16 Q To follow up on that, you said they
17 wouldn't be able to walk in and say, I treated
18 this catalyst and I'd be able to predict the
19 performance. But would you be able to like
20 provide an educated guess on what the impact of
21 those treatments would be?

22 A Well, I think, as we've had

1 discussion -- and a good one, I think -- that
2 generally, you know, base promotion is going to --
3 or base promoters, or promoters, if you just want
4 to put promoter, would have a chance of increasing
5 selectively.

6 As far as rate and temperatures, I think
7 that would be much more difficult to necessarily
8 just, you know, predict. But I think an operator
9 would probably walk in and go somewhere around
10 300-ish and, you know, probably go at a flow rate
11 of a weight hourly space velocity of 1 and start.
12 There would have to be just a -- and look what
13 comes out the end of the reactor.

14 And I think sometimes you're very
15 surprised. Sometimes you're not. Sometimes
16 you're the blind squirrel finds the nut.

17 Q Turn to paragraph 23 of your
18 Declaration.

19 A Okay.

20 Q In the last sentence of that paragraph
21 you say:

22 In my opinion, a person of skill in the

1 art would view the TOS achieved by the catalyst of
2 the '048 as being entirely unexpected.

3 When we were walking through the claim
4 earlier, we didn't really discuss the
5 time-on-stream as part of the claim.

6 Do you think that that's a feature
7 that's required by substitute claim 29?

8 A That's -- I'm getting confused with
9 science and legalities here, and patent law. I'm
10 not sure I can answer that. I honestly don't know
11 how to answer that.

12 Q If a catalyst had a poor time-on-stream,
13 do you still think it would read on claim 29?

14 MR. LUKAS: Objection. Vague.

15 A Yeah, I think I would have to think
16 about that. I'm sorry, it's tying the, you know,
17 physical performance of time-on-stream to a claim,
18 and I'd have to go look at that claim and be very
19 careful in how I answer that, Ryan.

20 I wish I could give you an answer, but
21 it's -- I'm seeing my so-called legal mind, or
22 patent mind mixing with my scientific mind, and

1 it's -- I think it's beyond something I can just
2 answer in this deposition. I'm sorry.

3 Q Skip ahead to paragraph 34. I was going
4 to kind of talk about 32 and 34 together here.

5 In paragraph 32 you acknowledge that the
6 PTAB relied on a definition of "person skilled in
7 the art" as a person with a bachelor's degree and
8 two or more years of experience, or master's
9 degree in organic synthesis, chemical engineering,
10 with education substituting for experience and
11 vice versa.

12 Do you see that?

13 A Yes.

14 Q Then in paragraph 34 it seems like
15 you're agreeing with that definition provided by
16 the Board; is that fair?

17 A I think I'll state I'm going along with
18 what the Board has approved. I'm not necessarily
19 in complete agreement that that's the case, but I
20 think it's been agreed on by the parties, and I'm
21 certainly satisfied in agreeing with it. I did it
22 in writing.

1 Q And that's the basis for your opinion --

2 A Correct, yes.

3 Q -- you use that a person skilled in the
4 art --

5 A Yes.

6 Q -- when viewing the prior art?

7 A Yes.

8 MR. MURPHY: I was going to move on to
9 the next topic, but we've been going for an hour.
10 Are you okay to keep going?

11 THE WITNESS: Yeah, I'm fine.

12 (A discussion was held off the record.)

13 BY MR. MURPHY:

14 Q I'm going to hand you what's been
15 previously marked as Exhibit 1007. This is United
16 States Patent Application Publication 2011/0196114
17 to Le, et al.

18 Do you recognize this document?

19 A Yes, I do.

20 Q Did you review it in preparation for
21 your testimony today?

22 A Yes, I did.

1 Q Can we turn to paragraph 63?

2 A Okay, I'm at 63.

3 Q So the last sentence there of 63 -- I
4 guess just one sentence, but the last half of it:

5 For example, a gamma alumina-based
6 catalyst, which may be acidic or basic, in the
7 presence of the alcohols obtained from starting
8 materials of renewable origin.

9 Do you see where it discusses that?

10 A Yes.

11 Q What would a person of skill in the art
12 understand the basic gamma alumina catalyst to
13 mean?

14 A Well, they're saying a gamma alumina-
15 based catalyst, not a basic. There's no basic.
16 So it's -- alumina-based would mean it's probably
17 a commercially available gamma alumina.

18 Q Referring to the next clause, "which may
19 be acidic or basic," so the "basic" in that
20 phrase, what would a person of skill in the art
21 understand that to mean?

22 A That they put in combination with some

1 water and measured the pH of that water, and basic
2 alumina would tend to turn basic pH greater than
3 7. So that would be a very broad -- if they just
4 said acidic or basic alumina, it would imply
5 nothing about pretreatment or anything like that.
6 You can buy basic and acidic alumina from Aldrich
7 Chemical Company. And that's alpha form.

8 But nevertheless, it's the broad term of
9 how acidic and basic is used. And it would simply
10 refer to, as I mentioned, you put it in water and
11 you measure the pH. That's what you'd see.

12 Q And how would the manufacturer then make
13 it acidic or basic?

14 A I wouldn't know how to do it. You know,
15 manufacturing, I'm not familiar how Aldrich or
16 other vendors of basic or alumina or acidic do it.

17 I certainly know when you talk about
18 Clariant or specific catalysts and somebody says,
19 I want to use incipient wetness or promoters and I
20 want to use this to induce a base or some sort of
21 reactive site into the catalyst, that I
22 understand. But how Aldrich makes their acidic

1 and basic alumina, I don't know.

2 Q And the next paragraph there, paragraph
3 64, the second sentence says:

4 According to a first version of the
5 invention, a basic catalyst, for example, a
6 barium-doped gamma alumina, is used to further
7 increase the selectivity of the dehydration.

8 A I'm sorry, wrong paragraph.

9 Q 64. The second full sentence says --

10 A Okay.

11 Q -- according to a first version of the
12 invention, a basic catalyst, for example, a
13 barium-doped gamma alumina, is used to further
14 increase the selectivity of the dehydration.

15 A Paragraph 64?

16 Q 64, yeah. So the first sentence is,
17 "The catalyst may be in the form of a powder"?

18 A Yeah. The second sentence --

19 Q The amount of -- I apologize, it's the
20 third sentence that I'm --

21 A Okay. I just -- I was ...

22 Q I miscounted.

1 A Okay. So according to a second version
2 of the invention, that's the third sentence.

3 Q According to a first version.

4 So the first sentence --

5 A Okay, all right, I gotcha.

6 According to a first version of the
7 invention. Okay, I'm with you.

8 Q So first, do you agree with that, that
9 you could barium-dope a gamma alumina catalyst to
10 increase the selectivity of the dehydration?

11 A Well, they didn't provide any numbers to
12 prove that, but they're saying that. And I think
13 barium oxide could be used as a promoter to
14 increase selectivity, yes. No data provided,
15 but ...

16 Q And would a person of skill in the art
17 know how to make a barium-doped gamma alumina
18 catalyst?

19 A As described in this, no, because
20 there's not enough details to make that catalyst
21 or understand. You can't simply say, I'm going to
22 dope it, and what was it calcined at? Was it even

1 calcined? Was there a calcination step? Did they
2 just wash it with a solution of barium and call it
3 quits? Did they assume it was calcined in the
4 reaction temperature?

5 So given what is stated here, could
6 somebody know that this is going to be a more
7 selective catalyst? I wouldn't bet my job on it.
8 If I was a chemical engineer at a company and I
9 had to throw that into a reactor and be guaranteed
10 it would be more selective, I wouldn't do it.

11 Q But if you're starting from this and it
12 says to use a barium-doped gamma alumina catalyst,
13 would you have -- or would a person of skill in
14 the art have the ability to figure out how to make
15 a barium-doped gamma alumina catalyst?

16 A They could start to go by trial and
17 error. Obviously, there's a lot of barium
18 compounds out there that one could use and try as
19 promoters. And could one be better than the
20 other? Could six of them not work? Absolutely.

21 So I, you know, in my opinion, this
22 doesn't give close, or near enough information to

1 allow practice of this claim or invention,
2 whatever you want to call it, step. It's a
3 statement. Could I reproduce that, being a
4 POSITA? No, absolutely not.

5 Q Earlier you mentioned -- I think you
6 did -- incipient wetness impregnation?

7 A Correct.

8 Q So is that a process that would work
9 with barium?

10 A Yes, it can. Yeah.

11 Q And so if you did incipient wetness
12 impregnation with a gamma alumina catalyst and
13 barium, you could create a barium-doped gamma
14 alumina catalyst?

15 A As I mentioned, it's -- when using
16 incipient wetness techniques, it's very dependent
17 on the form of barium that's introduced, and if
18 you calcine or you don't calcine, and what
19 temperatures range is effective. So those would
20 all be unknowns, and you would essentially be
21 inventing a new catalyst as far as I'm concerned.

22 Again, there's not enough information

1 there to say, you know, this would work. And it
2 may have worked, but again, I don't see, you know,
3 tables and data that say, here's our catalyst,
4 here's the time-on-stream, here's the selectivity
5 after six days, 10 days, and things that one that
6 was going to be operating that dehydrater would
7 want to know.

8 You simply don't let somebody give you,
9 do this and this and you're golden. Again, I
10 would not want my job to be dependent upon my boss
11 expecting the reactor to give me, you know,
12 1-hexene out of that reactor based on that
13 statement.

14 Q Okay. Could we turn to paragraph 171 of
15 Le.

16 A Okay.

17 Q I think the first full sentence -- see
18 if I can get this right this time. It's about
19 most of the -- three lines up from the bottom. So
20 we say:

21 It's containing a catalytic bed at a
22 temperature of 345 degrees C, consisting of a

1 layer of Eurosupport ESM alumina representing a
2 volume of ...

3 And the question is, if you're
4 maintaining a catalytic bed at 345 degrees C, can
5 calcination take place while you're maintaining
6 the catalytic bed at that temperature?

7 A You're asking questions that are good
8 for a Ph.D. study to undertake. And they're good
9 questions, and they're appropriate, but I want to
10 just say that if I was directing a student or
11 directing a worker or working with somebody, I
12 would say, well, calcination is usually done
13 without the presence of an alcohol in the reactor
14 at the same time.

15 Would the calcination be the same, would
16 it be as -- same performance? I would be -- I
17 would probably be doubtful, to be honest. But can
18 calcination occur at that temperature in the
19 reactor? Yes. Will it be the same calcination
20 that occurs without the alcohol present? That's a
21 question, again, I wouldn't assume.

22 Q Can we look at paragraph 184 of Le next.

1 A Okay.

2 Q So this is the composition of the fluid
3 at the reactor inlet, and they provide a table
4 below in paragraph 184 where they walk through the
5 products that are at the inlet of the reactor.

6 And so in each of these they have the
7 ethylene, the heptane, the nitrogen and the
8 hydrogen in each of these tests.

9 Do you see that?

10 A Yes.

11 Q And you mentioned in your Declaration
12 that there's no regioselectivity listed in Le?

13 A Correct.

14 Q And so the question would be, if there
15 was more than 170 parts per million of a 2-hexene,
16 would you expect to see it in this table?

17 A I have to be honest. First, I'm trying
18 to recollect what they're -- because they're
19 talking about reactor inlet.

20 Q Yes. The process starts at paragraph
21 173 where they take the output from the
22 dehydration reactor and they purify it and

1 undertake a polymerization step.

2 A So let me restate the question. You can
3 tell me if I'm way off-base.

4 You're asking me because the 1-heptane
5 is at .85 percent, that relates to selectivity of
6 the catalyst?

7 Q What I'm asking is that because the
8 output of the dehydration reaction is used in this
9 reactor, wouldn't -- if there was a significant
10 amount of 2-heptane created in the dehydration,
11 wouldn't we expect to see it at this inlet?

12 A Well, not having something listed,
13 because I can guarantee you there were a lot more
14 compounds than these four that they list, first of
15 all, so this is not a complete list.

16 And therefore, if they don't give me the
17 2-butene and the hexane ether and other products,
18 and hexanol, because my experience is that you
19 also produce aldehydes in these reactions at very
20 small scale.

21 So I would consider that a very
22 incomplete list and also make note that they talk

1 about purification step in 173. And so if this is
2 a purified stream that's coming back in, all bets
3 are off.

4 So what -- you know, they talk about a
5 step of purifying 1-heptane is performed before
6 carrying out the polymerization, dot, dot, dot.
7 So, you know, this fluid that goes back into the
8 reactor, I'm not quite sure where it came from, to
9 be honest.

10 Q Because the step of purifying, I think
11 that's what's being referenced, like this is the
12 steps of that purification.

13 A Yeah, well, I -- it just -- there's just
14 absolutely no way -- and you can see this in my
15 sort of -- any published study that's actually
16 detailed, there's not just one or two products
17 that come out of it.

18 This, in fact, discredits some of the
19 original 1940-ish type work when they go, well, we
20 make 1-hexene and 1-hep -- 1 -- 2-hexene, and
21 that's all they could see. Well, they had
22 instrumentation that was not very sensitive, so

1 on.

2 I think just having an incomplete list
3 there would make me very skeptical, and I would
4 never use that personally as a -- acting as a
5 POSITA, I would never use that to say this is a
6 selective catalyst.

7 I would have to see a table that said
8 you made some 2-hexene. Nobody makes 100 percent
9 1-heptane, 1-hexene, 2-octane that I've ever seen.
10 So when somebody tells me they are producing
11 1-heptane only, the bells and whistles go off.

12 And to your point, or to your question,
13 I would not use that as a metric of selectivity.

14 Q Okay. I'm going to hand you what's
15 previously been marked as Exhibit 1008. This is
16 United States Patent Application Publication No.
17 2005/0065389 to De Bruyn.

18 Do you recognize this publication?

19 A Yes, I do.

20 Q And did you view it in preparation for
21 your --

22 A Yes, I did.

1 Q -- testimony?

2 Can we turn to paragraph 37. And it's
3 the last sentence at the very bottom of page 3,
4 paragraph 37, where it says:

5 The catalyst may comprise a gamma
6 alumina catalyst or a promoted alumina catalyst.

7 Do you see that?

8 A Correct. Yes, I do.

9 Q Are you familiar with those promoted
10 alumina catalysts?

11 A Well, have I used those catalysts or can
12 I buy those catalysts? No. When somebody says
13 promoted alumina catalysts; i.e., calcium oxide
14 alumina or Ca-203 alumina, it doesn't specify many
15 things about the catalyst. They would need to be
16 specified to was it calcined, was it not, what's
17 the surface area, what's the pore size roughly
18 used in the experiment.

19 So am I familiar with that catalyst?
20 Just using that sentence, no, I can't say I would
21 be familiar with that catalyst or what it would
22 be.

1 Q You listed some things, but I guess what
2 other information would you need in order to make
3 use of the promoted catalysts that are listed
4 there?

5 A Well, I think I would phrase that what
6 would I need to go and make that catalyst and use
7 it.

8 Q Yes.

9 A I would have to be told what gamma
10 alumina they're specifying. In general, you know,
11 they have some spec requirements, but generally
12 would have to be a gamma alumina used with a pore
13 size and surface area. And I'd certainly have to
14 know how much calcium was used. You can't just
15 say calcium oxide. That can imply from
16 .001 percent to 99 percent. You know, there's no
17 ratio given.

18 So it's -- it's essentially -- one would
19 have to give -- and also how did they introduce
20 calcium oxide because calcium oxide, you can't
21 introduce that using incipient wetness or any
22 technique that I'm aware of, or a POSITA would be

1 aware of.

2 So information is, like saying I can --
3 I can fix your car. Just have it show up at the
4 garage and it will get fixed and you'll trust me
5 and you'll know how to fix it.

6 So it takes a lot more data, too. And
7 I'll certainly make note of, you know, my patents
8 and Inolex's patent '048, specifics such as how
9 much calcium was introduced and how it was
10 introduced in terms of the form. Calcium acetate
11 may not give the same reaction as other calcium
12 compounds.

13 So it's important in a specification to
14 me, in a patent so a POSITA can follow and use
15 that catalyst preparation, details like that need
16 to be given.

17 Q I'll ask it a little different way.

18 If a person of skill in the art was just
19 provided this catalyst, would they know how to use
20 it in a dehydration reaction?

21 A I think, as we mentioned earlier, a
22 POSITA would, you know, understand generally how

1 to load up a reactor and probably have an idea of
2 temperature range and flow rate to start with.

3 Not knowing any information about the
4 catalyst, and it would be pure, like a shot in the
5 dark, but it would be somewhat, I'll call it an
6 educated shot in the dark.

7 Q And then they'd most likely be able to
8 optimize it for whatever the optimum properties of
9 that catalyst are?

10 A Yeah. Could they, given time, do a
11 design of experiments, could they optimize a
12 catalyst given to them, yes, as an operator.

13 Q Can we turn to paragraph 53 of De Bruyn.
14 Talk about Example 3.

15 A Okay.

16 Q So the final two sentences there of
17 Example 3 says:

18 The reactor product (after removal of
19 the water and hexenes) was recycled to the reactor
20 at a mass ratio of feed to recycle of .75 to 2. A
21 total of 94 percent of the 1-hexanol was converted
22 to alkenes, with a selectivity towards hexenes of

1 98.6 percent, of which 97.5 percent was 1-hexene.

2 Do you see that?

3 A Yes.

4 Q Would a person of ordinary skill in the
5 art be able to optimize the conversion percentage
6 here if that was an important factor for them?

7 A Well, I think would they potentially be
8 able to come up with a design of experiments to
9 optimize the performance of a catalyst that was
10 given to them, I think that gets back to what we
11 just said, yes, you can.

12 Given a catalyst, one would be expected
13 to do a design of experiments and be able to
14 optimize that catalyst, but it is limited to the
15 performance of that catalyst, whatever it may be,
16 that you're handed.

17 So basically if you're handed a catalyst
18 that is going to degrade with time-on-stream,
19 there's nothing you can do to optimize it. That's
20 an important distinction to make. And that's
21 probably one of the biggest parameters that is
22 critical to commercialization of a catalyst, and

1 you can't optimize that by reactor design. That
2 is very, very difficult, and unattainable in my
3 mind.

4 Q Could we also look at your Declaration
5 at paragraph 43 where you talk about these
6 examples.

7 A Okay.

8 Q So about halfway down paragraph 43 is
9 when you state:

10 Also, De Bruyn is silent as to the
11 specific catalyst that was used for Example 3,
12 whereas a commercially available gamma alumina
13 Pural KR1 catalyst was used for Examples 4 and 5.

14 Do you see that?

15 A Okay. Okay, now I've read the
16 paragraph, I've looked at Example 3. Could you
17 restate your question, please? I'm sorry.

18 Q Well, you juxtaposed Example 3 with
19 Example 4 and 5 saying that there's a commercial
20 gamma alumina catalyst used in Examples 4 and 5,
21 but that there's not a listing in Example 3.

22 And the question is, why wouldn't a

1 person of skill in the art be able to use the
2 commercially available catalysts that are also
3 taught in De Bruyn for Example 3?

4 A So you're asking me to -- would I as a
5 POSITA just assume it would be okay to use the
6 catalyst used in 4 and 5 and that would be the
7 results I could see in 3?

8 You're saying couldn't I just take that
9 4 and 5 catalyst and wouldn't I just assume I
10 could move it to Example 3, which is a bit of a --
11 you know, has essentially a recycle stream and ...

12 (Reading.)

13 Let me state, looking at Example 3 --
14 and maybe this answers your question, Ryan, or it
15 doesn't, I'm not sure. Example 3 is a recycle
16 stream. And first of all, to compare that to
17 results in Table 4 are difficult, to almost
18 meaningless, because a recycle stream contains
19 much more than just 1-hexene and 2-hexene. It
20 will contain the ethers and the other byproducts.

21 And so, you know, looking at that
22 result, would I assume that that used the same

1 catalyst to get that result from a recycle stream,
2 I don't think I could make that assumption or that
3 they were using the same catalyst.

4 And that was, I think my point in my
5 deposition was. You know, first of all, they
6 don't call out the catalyst, and that's something
7 that somebody should do. And so I think that's
8 why I was, you know, saying, look,
9 there's essentially -- we have no such data as the
10 catalyst used, the time-on-stream, was it one
11 shot. And again, this is -- time-on-stream is
12 something I've mentioned earlier in the
13 deposition, that it's critical. And if you can't
14 maintain any selectivity with time-on-stream, you
15 don't have a viable commercial catalyst.

16 And I think my point there was he does
17 not provide any -- even if it was the same
18 catalyst that was used in 4 and 5, we don't know,
19 but you can assume that, would the behavior of
20 time-on-stream be the same given that's now a
21 recycling mixture and so on. And I would think
22 the answer would be no, I would not be able to

1 assume that as a POSITA.

2 Q And I guess, just to drill into that
3 recycling prong just a little bit more, what
4 impact would that typically have on conversion?
5 Just start with that.

6 What impact would recycling have on the
7 conversion of alcohol in the dehydration reaction?

8 A My experience is that it has a negative
9 effect because, in fact, you generate some
10 acidic-type compounds at the end of the reactor
11 from a dehydration. Very small, but you recycle
12 them again and again and again, and it can be
13 detrimental to the catalyst performance; hence,
14 conversion, high conversion numbers. And not
15 using a recycle stream are absolutely critical to
16 a commercial process.

17 Q Could you achieve high conversion for a
18 short period of time using the recycle stream?

19 A Yes, that could be possible. You know,
20 you get one passthrough, you know, 30 minutes.
21 You have to keep in mind, think about this in
22 terms of it going through your reactor. So when

1 you're talking about one recycle stream, it might
2 literally be your catalyst is on stream for five
3 minutes and you have to shut down the entire
4 reactor, cool it, and reload your catalyst.

5 Would anybody consider that, would they
6 do that? I think you and I can both look at, I'm
7 not unpacking that thing and turning it off every
8 five minutes to get one recycle stream. Is it
9 something a POSITA would look at, consider viable
10 in an industrial setting? I think the answer is
11 no.

12 In an academic lab, myself, including
13 Dr. Tabor, perhaps if we had graduate students, we
14 go, let's do this, let's try it, let's see what
15 happens on a recycle stream. Would somebody with
16 industrial experience looking at an industrial
17 process consider that? No.

18 Q Would that be one explanation for the
19 94 percent conversion that's listed in Example 3
20 is that they recycle it to create the higher
21 conversion?

22 A Well, I guess I don't -- it's a little

1 unclear to me, okay?

2 (Reading.)

3 You know, based on that paragraph, and
4 in all honesty, it just doesn't hold a lot of
5 credit, or water in my mind. I have no idea what
6 that recycle stream looked like. It only talks
7 about, you know, a ratio of feed to recycle, and,
8 you know, what does that recycle stream look like?
9 What was the conversion coming out?

10 I just -- I look at that and I have
11 really no way to know what that recycle stream
12 looked like. And that's, as I mentioned, that's
13 critical, that you can't be throwing just anything
14 onto your reactor and expect to get continued
15 performance.

16 So I -- there are a couple of reasons
17 that catalyst is not specified. The
18 time-on-stream, how many times did this work and
19 how long did they operate, so on. So there are
20 several things about Example 3 that leave gaps
21 that in essence doesn't help me bring that
22 invention to fruition -- reality. I think

1 frurulity is not a word.

2 Q Fruition?

3 A Fruition. That's the word, thank you.
4 Fruition.

5 Q Can we turn to paragraph 68 of De Bruyn.
6 And just looking at Table 10, which is
7 the dehydration results from Example 4, I believe.
8 And in this product, if we were to use the
9 recycling idea from Example 3 with the results of
10 Table 10 where we separate the 1-hexene -- or the
11 hexenes, you know, from the other products, we
12 would end up with a majority of the recycle stream
13 to be 1-hexanol and dihexyl ether, right?

14 A Yeah, the majority. There are other
15 components, but in there, you know, it says
16 2-hexene and so on. So, yeah, there are.

17 Q Yeah, I think they're saying they remove
18 all the hexenes. So you remove all of those.

19 A Okay. Yeah.

20 Q But then if you recycled what is
21 primarily 1-hexanol and dihexyl ether, would you
22 expect to have a greater conversion to 1-alkenes?

1 A I'm thinking about this. Certainly it's
2 a -- you ask tough questions.

3 But I guess what I'm looking at here is
4 that you're saying does putting this recycle
5 stream through somehow change their performance,
6 the conversion efficiency of that catalyst. And
7 if the first time through the catalyst you shot
8 out 26 percent hexanol and 17 percent ether, and
9 you're putting in new heptanol at the same time
10 you're putting the recycle stream through there,
11 and you're going to convert all of the sudden to
12 96 percent conversion, that would make no sense to
13 me that that could occur.

14 And also, you know, what is the actual
15 loading? I guess they give some, they give a
16 weight hourly space velocity of 8, so, at least
17 for this example, but -- and it looks like they
18 slow it down slightly for Example 3, but that
19 would be inconsistent in my mind that you -- a
20 catalyst that has this amount of conversion, you
21 stick through more alcohol in a mixture of hexanol
22 and ether and all of the sudden at the end the

1 catalyst starts having conversion of 95 percent.

2 That personally makes no sense to me.

3 A catalyst given a feed is going to have
4 a certain conversion, and putting in dihexyl ether
5 is not going to make that catalyst more reactive
6 in my mind. It's essentially an alcohol input.

7 So I'm confused in why couldn't you get
8 that same conversion by just putting heptanol
9 through there and getting the 1-hexene
10 selectivity. Why are you having to use a recycle
11 stream to get high conversion and selectivity?

12 Q I guess my question would be, on that
13 is, because you use a ratio of .75 feed to 2
14 recycles, so you end up recycling more -- you'd
15 end up with -- reusing the already-present hexanol
16 in the conversions.

17 That's why -- wouldn't that drive a
18 higher conversion, because you would be putting it
19 in slower and so it would -- you'd end up with
20 more contact on the catalyst from the originally
21 entered --

22 A It feels to me like this is perpetual

1 motion in that you somehow can take this unreacted
2 alcohol and ether, which is typically one thing
3 that the alcohols are converted to, putting that
4 back through and then saying, oh, what comes out
5 of the reactor, now I'm getting 95 percent
6 conversion. I'm having a hard time seeing how
7 that -- that isn't continually putting out
8 hexanol, so you're --

9 Q Aren't you -- oh, I'm sorry, I didn't
10 mean to --

11 A No, that's okay.

12 I'm conceptually having a hard time. I
13 haven't looked a lot, or thought a lot about
14 recycle. We did initially when I was like looking
15 at commercial processes for butanol chemistry and
16 we decided it was not fruitful whatsoever for
17 that. But your question is not -- your question
18 is this example here.

19 Q I guess what I'm thinking about it is
20 you're having less coming in, you know, you're
21 measuring what's coming in and going out, and in
22 the middle you're recycling it. So the conversion

1 would be constantly happening in the reaction and
2 you'd be recycling that thing because you're not
3 taking out all of the hexanol that's put in,
4 right? So it's -- you end up with a longer
5 residence time for each of the alcohols during the
6 recycling, wouldn't you?

7 A Well, we -- I think in continuous-flow
8 reactors -- maybe that's my difficulty here.
9 We're talking about continuous flow, and part of
10 when you have a recycle stream, you're slowing
11 things down at the beginning and trying to utilize
12 this recycling stream to, in theory, get more
13 conversion of your alcohol to the alkenes versus
14 converting it to a hexyl ether or something like
15 that.

16 And I'm not saying that that -- you
17 know, you can't have recycle streams. I --
18 certainly your point is well-taken and made. But
19 as you keep recycling on to that column, those
20 .24 percent impurities add up and so on, and so
21 it's -- I think, in theory, you could probably do
22 a reactor design where you somehow protected your

1 catalyst from this recycle stream.

2 In reality, it would be very, very
3 difficult. And I think that point -- I'm not sure
4 if I made it in my deposition, but it's not to say
5 that -- I think I actually specifically said -- I
6 certainly have said it in my patents -- that
7 adding steps and adding recycle streams become a
8 practical nightmare in commercialization, so ...

9 Q I'm not going to be able to find the
10 cite either off the top of my head. It says it's
11 expensive and --

12 A Yeah. Somewhere, I think I'm pretty
13 outspoken on that factor, that recycle streams are
14 conceivable, doable. The petroleum industry uses
15 recycle streams like crazy, but they have free
16 energy and their product is almost penniless, a
17 penny a pound, and they can do recycle streams to
18 a large degree.

19 But in the bio world -- and that's
20 something that, you know, you haven't brought up
21 yet. And I don't mean to misdirect us at all, but
22 in the bio world, you know, efficiency, atom

1 efficiency and things like that are absolutely
2 critical to commercialization. So processes or
3 inventions that can create atom efficiency,
4 process efficiency bring something to the process
5 that is critical for success.

6 Q Turn back to your Declaration, paragraph
7 45.

8 A Okay.

9 Q In the last sentence you say:
10 Summary of Le and De Bruyn's dehydration
11 conditions and results is provided in the
12 following table.

13 Do you see that?

14 A Yes.

15 Q And did you make this table yourself?

16 A Yes.

17 Q And you would agree that these are
18 specific examples provided in each of these
19 references and not necessarily representative of
20 the entire teachings?

21 A Well, I think I put them there because I
22 thought they were representative of what was

1 taught with enough detail to call teachings. So
2 yes, I mean they're examples I picked that I
3 thought related the teachings of the catalyst that
4 they had developed --

5 Q For example --

6 A -- to the patent.

7 Q For example, they teach broader
8 temperature ranges for dehydration reaction. So
9 this is a representation of one part, but not
10 necessarily the entire teaching?

11 A I think that's safe to say, that they
12 certainly, in their spec, have broader conditions.
13 As a scientist, or a POSITA, I like to use where I
14 have hard data in table form that they presented
15 in representative of examples. And so I will tend
16 to pull examples if somebody gives in a patent as
17 a metric and a measure of what their spec can
18 deliver.

19 I think it's safe to say that usually
20 you would like to put your best foot forward in
21 terms of getting the patent clerk to agree this is
22 really a good catalyst, so you would probably put

1 your best foot forward in terms of tables and
2 data. And to enable the catalyst and so on for
3 commercialization you need that kind of data. You
4 need numbers to look at as a POSITA.

5 Q I was going to ask if we can draw some
6 conclusions from this table that you put together.

7 Is it fair to say that based on the
8 three columns that you have of De Bruyn, that as
9 we decrease the flow rate, our conversions are
10 going to increase?

11 A I would say that's a general trend, yes.

12 Q And similarly, as we increase the
13 temperature, the conversions would increase?

14 A Yeah, conversion would increase.

15 Q And those increases in temperature
16 and/or reducing flow rate don't appear to impact
17 the regioselectivity that much; is that a fair
18 statement?

19 A No.

20 Q I'm just looking at the 1-alkene
21 regioselectivities here, and we're going from
22 280 degrees C to 315 C, and it looks like the

1 regioselectivities are largely unchanged.

2 A We were talking about conversion and
3 regioselectivity, I thought, when you talked about
4 temperature changes. So you're talking about
5 temperature change -- will flow rate or
6 temperature change affect selectivity? Maybe I
7 need you to restate the question, I'm sorry.

8 Q The first thing we walked through, which
9 we did, was that conversion was impacted by flow
10 rate and temperature --

11 A Correct.

12 Q -- which you said were general
13 statements --

14 A Correct.

15 Q -- that were true. And then I was
16 asking the next, the follow-up would be, as we
17 alter the temperature, it appears that the
18 regioselectivity is largely unchanged. And is
19 that fair to say, that it doesn't have a large
20 impact on regioselectivity as you alter the
21 temperature?

22 A Well, first, I would have to say what

1 are you defining as large in terms of temperature
2 change, because are you calling one degree large,
3 or 50 degrees here?

4 And that's, you know, we're talking
5 about -- this is an example, 25-degree temperature
6 change, is that large or not. But in general,
7 higher temperatures can lead to isomerization
8 reactions. And the higher you have to go, the --
9 there's a good chance you're going to see more
10 isomerization.

11 I can say in my work with the butanol
12 catalyst that we did the gamut of temperature
13 variations and we had great performance at 370,
14 and we went up to 390 and the selectivity went
15 down. We could go through the reactor faster and
16 so on, but our selectivity went down. So I've
17 seen examples myself where temperature can have a
18 deleterious effect on selectivity.

19 So, you know, can I go, for this
20 catalyst and this alcohol, can I take my work in
21 the Navy and Cobalt Technologies of butanol and
22 translate here one-to-one? If that was the case,

1 my catalyst would have worked for Inolex and we
2 wouldn't have a silanized catalyst dehydrating
3 alkanol. So things don't always translate from
4 this column to that column.

5 That, given my -- I would say my
6 experience says I would expect a decrease in
7 selectivity with an increase in temperature, in
8 general. And probably not just a degree at a
9 time, but, you know, 10 degrees or 15 degrees,
10 20-degree changes.

11 Q I know we kind of went through this a
12 little bit more, but to clarify on this particular
13 table, you don't address the recycling that we
14 were discussing with Example 3; is that right?

15 A I did not state that that was a recycle
16 stream. So I mean I -- in my mind, I -- well, if
17 you look at note 1 -- let me make sure before I
18 carry on here. I need to ...

19 (Reviewing.)

20 Okay. So I just want to make sure.

21 Note 1 was basically what we already talked about,
22 that Example 3 would be difficult to reproduce

1 because there's so little.

2 And I did not, in Example 3 in this
3 table, mention it had a recycle stream. I again
4 mention the data is sort of insufficient to sort
5 of reproduce or analyze that data.

6 MR. MURPHY: I'm at another good
7 stopping point if there is interest.

8 MR. LUKAS: If we could go off the
9 record, that'd be great.

10 (A recess was taken at 11:25 a.m.)

11 (Back on the record at 11:34 a.m.)

12 BY MR. MURPHY:

13 Q Dr. Wright, I'm going to hand you what's
14 previously been marked Exhibit 1025. This is U.S.
15 Patent 4,234,752 to Wu, et al.

16 Do you recognize this patent?

17 A Yes.

18 Q Did you review it for your, prior to
19 your testimony today?

20 A I did not review this one.

21 Q Well, let's turn to Example 2, which is
22 column 3, around line 39, and it goes over to 4,

1 14. Do you see that?

2 A You say column ...

3 Q Column 3.

4 A Okay.

5 Q Example 2.

6 A Oh, Example 2. I got it. Okay. Sorry.

7 Q So at the beginning of that second
8 paragraph that starts right around column 3, line
9 43, it says:

10 Gamma alumina was base-treated by mixing
11 gamma alumina and an aqueous solution containing
12 30 grams of KOH in 7.6 liters of water.

13 Do you see that?

14 A Yeah.

15 Q Would a person skilled in the art
16 understand this to be a base-treated catalyst?

17 A Yes. One would assume that to be a
18 base-treated catalyst. Of course that depends
19 what else they do after the treatment with KOH,
20 but one would generally look at treatment with KOH
21 as a base treat.

22 Q And then if we go to the top of column

1 4, they talk about after washing it, they say:

2 The thus-treated alumina was dried at
3 82 degrees C at reduced pressure with a nitrogen
4 purge.

5 Do you see that?

6 A Yes.

7 Q Would a person skilled in the art
8 consider that to be a calcination step?

9 A No. I think this statement would be
10 that that's too low a temperature to -- let me --
11 I may have jumped ahead, or stated too far behind.

12 You said, thus-treated alumina was dried
13 at 82 degrees centigrade?

14 Q Yes.

15 A Would I consider that calcination? No.

16 Q After treating the gamma alumina with
17 the KOH, would it be a standard practice to
18 calcine the catalyst?

19 A Well, calcination is not a required step
20 to prepare a catalyst, so I think the answer to
21 that, do you have to calcine to make an active
22 catalyst of some sort for some process? No.

1 Q But would it be a common step to take
2 after treating it with the KOH?

3 A Well, is it practiced in the art? Yes.
4 Is it common or is it assumed? No. I would not
5 assume because they didn't put a calcination step
6 that it was calcined.

7 I would not assume that, if I was a
8 POSITA and I was looking at that, I would go, they
9 don't calcine, just take it out of the oven at
10 82 degrees.

11 In this case, they say a reactor was
12 packed so they would pack it with 10 kilograms of
13 material and turn on the heat, alcohol, nitrogen
14 right at the top of the cone and so on. So they
15 essentially loaded it up, turned on the heat, and
16 put the alcohol through the reactor.

17 Q Would a person of ordinary skill in the
18 art reading this want to calcine it after
19 treating it with the KOH?

20 A I guess I'm trying to -- is calcination
21 something that you would, as a POSITA, would you
22 automatically do if it's not instructed, and the

1 answer would be no. I mean if I was -- I was a
2 POSITA operating in an installation and here were
3 the instructions, I would follow the instructions
4 to keep my job. I would not calcine it and go,
5 well, they must admit they were going to calcine
6 it because everybody calcines their catalysts. I
7 wouldn't make that assumption.

8 So I'm trying to say I wouldn't look at
9 the calcination and know what temperature to
10 calcine at. So there's just -- would I take that
11 risk that I calcine it and all of a sudden the
12 catalyst is destroyed or not active or so on. So
13 I would not do it.

14 Q Would a person of skill in the art
15 reading this understand that there would be any
16 benefit to calcining it after treatment with the
17 KOH?

18 A Reading this I would say no because, you
19 know, it's not an incipient wetness technique,
20 which usually implies you're going to calcine.
21 Not always there, but it's more typical, I would
22 say, of incipient wetness.

1 This is a washing of a solution. It's
2 actually more similar to what I did with the Navy
3 work in terms of washing with sodium hydroxide
4 solution. It was not incipient wetness, but
5 simply making it a basic alumina. And in my mind,
6 there is a drastic difference between just washing
7 with base and drying it and throwing it in a
8 reactor versus applying something like some
9 promoter that you choose and carrying out
10 calcine.

11 Q So would the potassium be a promoter in
12 this context?

13 A Well, at this point you really have no
14 idea if the potassium stays behind. You would
15 sort of assume, because it's basic, that there's
16 some 0-minus potassium plus sitting on the
17 surface.

18 But I'm not sure I can say I've seen
19 that or seen that proven in terms of it changes
20 the basicity of a catalyst, which I think I
21 mentioned earlier, you wash it with a base
22 solution, you put it in water, you would expect to

1 see some base behavior.

2 I guess what I didn't specify is what is
3 that base that's created in the aluminum oxide.
4 What is the counter ion -- cat ion, excuse me,
5 in that. And you can assume it's calcium and --
6 but that's not -- calcination would say, okay,
7 that's just sitting on the surface. It's -- you
8 could wash it with water and the calcium could go
9 away. It could drift off with the alcohol
10 reaction and the dehydration reaction. It's not
11 secured within the structure.

12 And I think I mentioned before
13 calcination is a chemical change. So what I see
14 here is they do a wash, they create different base
15 sites. In some ways that's a chemical change, but
16 something that's very easily reversed.

17 I can wash that with acid or over time
18 water could just wash away the base, and if it had
19 a slightly lower pH, your base washing would be
20 nullified.

21 So I guess I'm saying this is a very --
22 not that I haven't used techniques similar to

1 this, but this is very different than what we
2 would call, like what the '048 patent used or
3 something. As a POSITA, I would consider those
4 two very different processes.

5 Q And then at the top of the next
6 paragraph, so column 4, around line 5, we have:

7 Tubular reactor, with 3.66 meters by
8 7.6-centimeter ID was packed with 10 kilograms of
9 base-treated gamma alumina. Reactor was
10 maintained at 350 degrees C and 310 to 350 KPA.

11 Do you see that part?

12 A Correct.

13 Q We probably touched on this before, but
14 in this context, would maintaining the
15 base-treated gamma alumina at 350 degrees and
16 increased pressure prior to introduction of the
17 alcohol be considered a calcination step?

18 A If it was maintained for a significant
19 time before alcohol was introduced, would I read
20 that and say that catalyst was calcined? No.

21 If they had put -- was heated at
22 350 degrees under a flow of nitrogen, or under

1 pressure for 12 hours or 24 hours, certainly that
2 could -- you can have your reactor look something
3 like an oven as long as you can make sure things
4 didn't happen in your reactor as you calcined in
5 your reactor.

6 Typically people don't calcine in their
7 reactor because of what would be done to the
8 surface of your reactor, and have you really
9 gotten everything out from calcination because
10 calcination involves also ejection of other
11 molecules, depending on what you dope with. But
12 typically you would not like to do that in your
13 reactor.

14 You know, as a POSITA, I would say
15 you're not putting that stuff in my reactor and
16 going to heat it up and generate potential
17 byproducts and then expect reproducible behavior
18 of that catalyst. So those are the constraints.

19 I would say that, you know, calcination
20 is a heating for hours. And, you know, we've had
21 that discussion, well, how many hours is enough,
22 and I think I would use the general range of 12 to

1 24 as just an accepted, I think established
2 metric.

3 Q I'm going to turn over to Example 1 now,
4 which is in column 3, right around, starts right
5 around line 9.

6 A Uh-humh.

7 Q Do you see that?

8 A Okay, got it.

9 Q And this is a similar reaction that we
10 just discussed, except the gamma alumina has not
11 been base-treated. Is that your general
12 understanding as well?

13 A Yeah. I think if somebody just says
14 gamma alumina, you have to take them at heart that
15 that's gamma alumina, correct.

16 Q But they do provide some numbers for the
17 output of the reaction in what we'll just call it
18 Table 1 at the bottom of that Example 1.

19 A Correct.

20 Q And my question is, in the invention
21 which is Run 1 of the table, we achieve a
22 90 percent yield and 96.4 percent selectivity and

1 93.4 percent conversion.

2 Do you see that?

3 A Yes.

4 Q If we used the base-treated catalyst of
5 Example 2 in that similar reaction that's
6 represented by Table 1, would we expect the
7 selectivity to increase?

8 A Over the comp -- I guess you're talking
9 about the results in Table 1. Which result line
10 are you talking about?

11 Q Run 1, which is their invention, which
12 is their use of the gamma alumina in the reactor.

13 A So Example 1?

14 Q Exactly.

15 A So you're saying Example 1 is the
16 invention?

17 Q Yes.

18 A And you're saying for the 3-methyl,
19 1-butanol, they get a yield of 90 percent?

20 Q Uh-humh.

21 A Their comp is -- I guess I have to go
22 through the spec and know what their comp was. I

1 don't know what their comp was.

2 Q What do you mean by "comp"?

3 A Well, I'm reading line 2 --

4 Q Run 2?

5 A -- it says comp. So they're saying no
6 nitrogen. So they're telling me that nitrogen had
7 this effect on the performance of the catalyst,
8 and I guess they're saying -- is this five minutes
9 of run, or 10 minutes of run, or -- I'm trying to
10 look at that time-on-stream.

11 Okay. So I need you restate your
12 question, Ryan.

13 Q So if we used a base-treated gamma
14 alumina catalyst in Run 1 where it says you had a
15 90 percent yield, 96.4 percent selectivity, and
16 93.4 percent conversion, would we expect the
17 selectivity to increase?

18 A I don't have any data to, especially for
19 that alcohol, to say one way or another. I think
20 looking at that, the data in terms of the
21 selectivity and conversion, those are obviously
22 very high numbers for gamma alumina itself, which

1 would contradict many publications that don't show
2 those high of numbers for conversion.

3 So it says to me 3-methyl, 1-butanol is
4 somewhat different than the alcohols -- the linear
5 alcohols that my experience, or my POSITA
6 experience would say.

7 So this is -- you're asking me would
8 base make this better than something that already
9 appears better than would be expected for a linear
10 alcohol. And of course, they don't mention the
11 inevitable time-on-stream and the effects of
12 time-on-stream, but there's nothing in here that
13 says base treatment, that I can see, provides a --
14 in terms of data, provides a higher selectivity.
15 So would I assume that? I guess the answer to
16 your question is no, Ryan.

17 Q Because I think earlier we were talking
18 about how it was impacting the, what Bronsted
19 cites and we treat it with a base. So would this
20 treatment not have that same impact?

21 A Well, I look at where we're starting,
22 and, you know, I would look at that and say,

1 you're starting at numbers that are already for a,
2 the best-of-the-best catalyst out there. And I'll
3 use catalyst, the Inolex catalyst as an example of
4 that, as an example.

5 Now you're saying, if I put base in
6 there, am I going to get even more performance
7 increase. And it's already behaving different
8 than I would expect, to be honest. You know, I
9 think it's probably part of the reason they got
10 the patent, looking at that, that those numbers
11 are exceptional. There's no time-on-stream data
12 for that, but those numbers are exceptional for
13 just gamma alumina for an alcohol.

14 And of course it's not 1-hexanol, it's
15 not 1-heptanol, it's not 1-octanol, it's 3-methyl
16 butanol. Why would that be different? Would it
17 behave the same if you base treat the catalyst?
18 That's where I'm saying I would not be convinced
19 that, my POSITA experience would say yes, base
20 treatment, eliminating isomerization sites, is
21 beneficial. I stand by that statement
22 unequivocally.

1 Eliminating isomerization sites with
2 strong Lewis acid, or sites -- acidic sites is
3 fundamentally important to keeping high
4 selectivity. Nothing to do with conversion. High
5 selectivity.

6 What I see in this example is they
7 already achieve very high selectivity for an
8 alcohol, for a branched alcohol. That surprises
9 me because I wouldn't use them as an example for
10 either going to my boss and saying, as a POSITA,
11 saying, hey, let's use this chemistry. It works
12 for 3-methyl butanol. And he might go, well, show
13 me something that's closer to our alcohol. What
14 does 1-butanol do with just straight alumina? And
15 of course, in Inolex's work, straight alumina was
16 tried and the results were not this, did not
17 achieve that regioselectivity.

18 So I think the broader question is can
19 that alcohol translate and be used as precedence
20 for linear alcohols. And it's a fair question. I
21 just I wouldn't, what I'm seeing in the data, and
22 I wouldn't use that to discredit a new catalyst

1 performance based on what this example did. It's
2 very limited in a different structure.

3 Q Let me ask this a different way.

4 What impact does the increased pressure
5 have on the results shown in the table for
6 Example 1?

7 A I'm trying to look at it and make sure,
8 was there a pressure difference between those two
9 runs, or was it just they had a nitrogen purge?

10 (Reviewing.)

11 I'm not sure I see that there's a
12 pressure difference between those two runs other
13 than the nitrogen was a diluent. Does that make
14 sense? It isn't necessarily true that just
15 because they used nitrogen it was used at a higher
16 pressure.

17 And of course, you know, when you used
18 the nitrogen -- I'm trying to look at weight
19 hourly space velocities. It's a little -- it
20 talks about the flow rate of the nitrogen. I --
21 as a POSITA, I would say that I would assume that
22 they were run at the same pressure.

1 So I think the question might be --
2 maybe this is what you're asking, Ryan. I
3 apologize if I miss -- is what was the effect of
4 nitrogen dilution in the reactor?

5 Q Yeah. It seems like Wu's, one of their,
6 one of the premises that they're operating under
7 is that an increased pressure leads to a better
8 reaction. And I guess I was curious, you know, in
9 your opinion, what was -- you know, how does that
10 impact the reaction by increasing the pressure?

11 A Well, I can tell you as a -- put on the
12 expert hat, having looked at catalyst
13 performances, and this is butanol, again, not
14 octanol, because we didn't do any significant
15 pressure studies in Inolex that I can remember.
16 But that pressure doesn't have a -- and this was
17 only from zero to about 50 PSIG, so not huge,
18 but -- significant, but not, in the game of
19 pressure reactors, not huge because pressure
20 invariably changes depending on how big your
21 reactor is, how much pressure you have to start,
22 and of course pressure changes over the reactor

1 dimensions.

2 So we ran some pressure changes and the
3 pressure itself did not appear to really change
4 selectivity. So I, as an expert, I can, from that
5 advice, I can tell you from that I can give some
6 sort of a statement that I don't see pressure as
7 being a huge factor in selectivity. That that
8 wasn't something that, oh, my gosh, we get up to
9 50 PSIG and our selectivity starts falling off.
10 We didn't see that at those modest pressure
11 changes. That was my expert hat.

12 As a POSITA, I would look at this, and
13 sort of analyzing this result, we really don't
14 know if there was a pressure change. And the
15 reason they got, you know, higher conversion was
16 simply they diluted the alcohol within the
17 mixture, and in fact was putting it -- it almost
18 is equivalent to what we talked about before. We
19 decreased the rate of input because they had more
20 nitrogen and less alcohol, so the amount of
21 alcohol going through the reactor, and that's why
22 I don't have a number of what the weight hourly

1 space velocity was. So, you know, I can't -- it's
2 hard from that to look at that and say, you
3 know ...

4 Q I guess theoretically we know that it's
5 18, about 18 milliliters an hour, and we know we
6 have about 24 grams. I haven't done that, so I'm
7 not going to ask you to do it on the fly.

8 A Because you got to go --

9 Q Thinking out loud.

10 A No, it's -- you're correct.

11 (Simultaneous speaking.)

12 Q -- the information available if we, I
13 think, right?

14 A Well, yeah. I mean what I guess I'm --
15 they're assuming is that for both, both runs, the
16 flow rate of alcohol was the same, and
17 invariably -- well, then it's counterintuitive
18 because that would mean nitrogen was going to
19 decrease the time in the reactor. And then I
20 really start going, wait a minute here. They're
21 taking the same flow rate and increasing, and
22 adding a dilutant, and yet they're getting more

1 conversion. And that would be counterintuitive
2 because, back to my expert hat, we look at
3 nitrogen purges and effects of nitrogen purges and
4 it was just, it really had no effect.

5 It was, it was time that the catalyst
6 was exposed to the alcohol and the temperature
7 you're operating at. And, of course, the time
8 that it's exposed to the catalyst is controlled by
9 your flow rate. And those are --

10 So nitrogen, putting in nitrogen is
11 going to scoot your alcohol through there faster.
12 So if somebody told me they got more conversion by
13 putting nitrogen gas in there and kept the flow
14 rate of alcohol the same, I'd say wait a minute,
15 can I see that result? Can I watch you run that
16 experiment? It's counterintuitive to me.

17 My guess is they somehow slowed the flow
18 rate down in the alcohol and then had a nitrogen
19 purge in there, because nitrogen doesn't cause a
20 surface to be more reactive. My general knowledge
21 of -- you don't put nitrogen in there. You dilute
22 to cause -- if not, you know, clogging of the

1 catalyst and so on, so forth. But you don't use
2 an inert gas purge to create a more active
3 catalyst surface. That would be something a
4 POSITA would go, okay, so I put a nitrogen
5 through, I get a more active catalyst. I would
6 run to the Patent Office very quick with that if
7 you have the data to show that.

8 Don't you love these three-page patents
9 back in the '80s, '70s, '60s?

10 MR. MURPHY: Ask you to mark this one
11 Exhibit 1039.

12 (Exhibit 1039 was marked for
13 identification and is attached to the transcript.)

14 Q We've handed you an International Patent
15 Publication No. WO 2015/130451 to
16 Cobalt Technologies, and the first inventor is
17 Michael Wright.

18 Do you recognize this document?

19 A Yes, I do.

20 Q Are you the Michael Wright that's listed
21 here?

22 A Yes, I am.

1 Q I'm going to refer to this as the Wright
2 '451.

3 A I'm going to write on the page here so I
4 don't forget your numbers.

5 Q '451. Just the last three.

6 A That's cool. Yeah.

7 Q Can you look at the abstract? That
8 first sentence in there says:

9 The present invention relates to the
10 preparation of a dehydration catalyst and a method
11 and apparatus for dehydrating 1-alcohols to
12 1-alkenes with high regioselectivity.

13 Do you see that?

14 A Yes.

15 Q Do you recall that this is a
16 specification that dehydrates alcohols to alkenes
17 with high regioselectivity?

18 A Oh, yes.

19 Q And then can we flip over to
20 paragraph 2.

21 In paragraph 2 the first sentence says:

22 The invention generally relates to the

1 conversion of terminal alcohols to the
2 corresponding terminal alkenes with high
3 regioselectivity at high conversion.

4 Would you agree that this is teaching
5 how to dehydrate terminal alkenes with high
6 conversion?

7 A Yes.

8 Q I'm going to flip over to paragraph 13.

9 And the second full sentence of
10 paragraph 13 says:

11 In some embodiments, the terminal olefin
12 is produced with about 90 percent to about
13 99 percent regioselectivity.

14 Do you see that?

15 A Yes.

16 Q Is that teaching a person skilled in the
17 art that you can dehydrate terminal alcohol to a
18 terminal olefin at between 90 and 99 percent
19 regioselectivity?

20 A Well, I guess I see a difference between
21 teach and making a statement that it can be done.
22 I guess so.

1 Q Is it reflective of the document that --

2 A The embodiments in the patent, yes.

3 Yes.

4 Q So in the next sentence:

5 In some embodiments, a single pass over
6 the catalyst system affords a chemical conversion
7 of greater than about 95 percent.

8 A Yes.

9 Q Is that reflective of the embodiments in
10 this patent that teach how to make a conversion of
11 greater than 95 percent?

12 A Yes.

13 Q And then at the top of paragraph 14, the
14 first sentence:

15 Catalyst compositions disclosed herein
16 contain inorganic support modified by a calcium
17 compound as one preferred embodiment.

18 A Yes.

19 Q Is that reflective of the embodiments in
20 the specification that teach how to modify the
21 gamma alumina catalyst --

22 A Yes.

1 Q -- with calcium?

2 A Yes.

3 Q If we turn to page -- it's still
4 paragraph 14, but it breaks over to the top of
5 page 5.

6 A Okay.

7 Q The second full sentence there, it says:
8 Calcium imparts an increase in the
9 reaction rate when compared to Group I metals,
10 such as sodium and potassium, when used at a
11 similar weight percent loading values?

12 A Uh-humh.

13 Q Do you agree with that statement?

14 A Yes. It was proven experimentally.

15 Q And then the next sentence:

16 Furthermore, calcium provides an
17 increase in selectivity for a terminal alkene
18 product over use of Group I metals at high and
19 comparable terminal olefin conversion.

20 A Yes.

21 Q And is that also reflective of the
22 teaching in the specification?

1 A Yes, it is.

2 Q If we turn to paragraph 22. The final
3 sentence there, pretty short, but it says:

4 In some embodiments, the 1-alkene
5 produced include less than about 5 percent
6 unreacted 1-alcohol.

7 A Uh-humh.

8 Q Would you take that to mean greater than
9 95 percent of the alcohol is converted in the
10 reaction?

11 A Yes.

12 Q Then at paragraph 27 it says:

13 In some embodiments, the reaction
14 mixture is heated to a temperature of about 200 to
15 about 440 C.

16 A Yes.

17 Q Is that teaching that dehydration
18 reactions can take place at those temperatures?

19 A Yes.

20 Q If we turn to paragraph 60. This we
21 touched on briefly before. It's a paragraph that
22 explains what the incipient wetness impregnation

1 process is.

2 A Okay.

3 Q And you see how in this it explains that
4 you modify support material by treating the solid
5 material with a predetermined amount of solution
6 containing at least one desired modifier; e.g.,
7 calcium acetate?

8 A Yes.

9 Q Is that like the known way of running an
10 insipient wetness impregnation process?

11 A It's a good example, yes.

12 Q Okay. Can we turn to paragraph 67?

13 A Okay.

14 Q I'm just going to kind of walk through
15 this process that it's talking about here.

16 So the first sentence, 67, it says:

17 In some embodiments, calcium compound is
18 dissolved in one or more solvents to create a
19 solution, and the solution is placed in contact
20 with a carrier; e.g., gamma alumina, and the
21 solvent is removed; e.g., with heat and/or reduced
22 pressures.

1 Do you see that?

2 A Yes.

3 Q Is this teaching you can modify gamma
4 alumina catalyst with calcium?

5 A Yes.

6 Q And then we're going to skip a sentence.
7 So the third sentence says:

8 IWP -- which in this case is referencing
9 incipient wetness impregnation -- is typically
10 followed by a drying or calcination process for
11 some time as shown schematically in Figure 2. The
12 inorganic support is added to the vessel 201, and
13 then an addition of IWP solution is done in such a
14 way as to provide even distribution.

15 Do you see that?

16 A Yeah.

17 Q And that's an accurate representation of
18 how to undertake an IWP process?

19 A It's one way to do it, yes.

20 Q Then we're going to skip three sentences
21 to four sentences down from that. It says:

22 This material 204 can further, can be

1 further heated in a second apparatus 205 to
2 provide drying or calcination of the catalyst.
3 The drying or calcination can be carried out in
4 vessel 203 or 205 at temperatures of about 100 to
5 about 900 C or about 200 C to 600 C for a period
6 of time of one hours to eight hours or two hours
7 to six hours.

8 Do you see that?

9 A Yes, correct.

10 Q And is that an accurate representation
11 of how to calcine a gamma alumina catalyst after
12 an incipient wetness impregnation process?

13 A Can you find a combination of those
14 parameters that would, you know, work? In other
15 words, can you be at 600 degrees C and go for four
16 hours and consider that complete calcination? One
17 would have to test it, but that was the range that
18 we called out. Was it physically tested, proved?
19 No.

20 Q Would a person of ordinary skill in the
21 art understand that within this range they would
22 be able to achieve calcination?

1 A Well, you've got two variables. So
2 you're talking about could they find a set of
3 variables between 100 degrees and 900 degrees and
4 one hours and eight hours to calcine?
5 Potentially, yes.

6 Q And then the narrower range, 200 to 600,
7 would they be able to utilize that smaller range
8 to calcine the gamma alumina catalyst?

9 A Yes, it's possible. Again, you know,
10 did we in this work run a catalyst at 600 degrees
11 for six hours and prove that it was calcined?
12 These are ranges that were taught, or expected to
13 be able to teach, but -- I'm trying to think of
14 the best way to say this.

15 It depends on scale. And I know these
16 numbers work for smaller-scale preparations, and
17 so it's -- scale is a factor in this. And these
18 were, in fact, very small-scale reactions, talking
19 about half a gram or less. And heating up
20 materials and getting, you know, heat consistent
21 through the material is different.

22 So would those numbers work for a, you

1 know would a POSITA go, I can take 10 kilograms or
2 two metric tons and do that? I would be skeptical
3 if it would work.

4 And so the numbers we talked about
5 earlier, between 12 and 24 hours, was assuming
6 you're not concerned about batch size or this
7 would work for varying sizes. The work with
8 Clariant, which this work was done with Clariant,
9 were smaller-scale catalyst batches. So I think
10 that needs to be sort of kept in mind. We didn't
11 specify the size of the catalyst batch that was
12 being calcined.

13 Q So this would work more like, you're
14 talking a lab scale. This would be an
15 appropriate --

16 A Yeah.

17 Q -- an appropriate process to undertake
18 in a lab scale, for example?

19 A I would say a POSITA would look at this
20 and say, okay, that was potentially done at a
21 small scale. Or I would just, in fact, write the
22 company, did you ever do that at a larger scale?

1 And I would assume that we would probably have to
2 run it at longer times just to make sure we heated
3 the entire sample, and so on.

4 So, you know, because when you heat a
5 sample, it changes throughout the sample, and
6 getting 600 degrees on the outside is very
7 different than getting 600 degrees on the inside
8 of a mound of material.

9 So I think, you know, this work, I know
10 when Clariant was working at it, it's in their
11 testing laboratory, and their reactors were,
12 contain milligrams of catalysts that we did these
13 studies on and essentially got the data to support
14 this. So this reflects Clariant's analytical data
15 done at a very small scale.

16 So I think that needs to be, as we talk
17 about this teaching, would it translate one-to-
18 one, so can this be commercialized using these
19 steps? My expert opinion would probably be no.
20 My POSITA opinion might be, well, let's give it a
21 try. If it doesn't work, we'd better heat longer
22 or we'd better play with the temperature.

1 So I think that the time is what I'm
2 concerned about. That's a very short time for
3 trying to heat a large mass.

4 Q I guess going back to your original
5 point is that you can, calcination is when the
6 chemical process is completely complete. So a
7 person of ordinary skill in the art would be able
8 to figure out when it's been complete and then
9 utilize that time frame for even a large-scale
10 reaction?

11 A Yes. I mean, in this case, you can do
12 it by weight loss. You can watch, you know, the
13 weight decrease, and when you get leveled off, if
14 you could take a sample out and put it in a
15 thermogravimetric analysis machine and say, okay,
16 we've achieved where there's complete reaction or
17 calcium acetate has been converted over to calcium
18 oxide.

19 This is part of where we were talking
20 about earlier, giving off acetic acid, what's that
21 going to do to my reactor? That's why we don't do
22 these things typically in a reactor because you're

1 giving off other things as you calicine. It is a
2 chemical reaction of some sort.

3 There would be ways to test, a POSITA
4 would say, okay, here's their range. Is it
5 realistic for my batch size? If I contracted a
6 company to make this catalyst for me, I'll give
7 them what the patent says, it says, let's see,
8 okay, let's take this with a grain of salt and we
9 might have to go longer, but hopefully find
10 something in that temperature range, if the patent
11 is valid, which I know this work is valid.

12 Q Can we turn to paragraph 77 now. And I
13 think it's the third full sentence. It says:

14 Output 401 is transferred to vessel 403
15 which contains the dehydration catalyst 206 or 304
16 prepared above at an elevated temperature, for
17 example, about 200 degrees C to about 440 C or
18 about 300 C to about 420 C.

19 Do you see that?

20 A Yeah.

21 Q And the dehydration catalyst 206 is the
22 one we just talked about the process for creating,

1 correct?

2 A Yeah. You're kind of moving a little
3 fast for me here.

4 Q Okay. Paragraph 67. So it breaks onto
5 page 15.

6 A Okay.

7 (Reviewing.)

8 Q It says, "producing the finished
9 catalyst 206." On the second sentence on page 15.

10 A (Reviewing.)

11 Okay, so I've got -- so just make sure.

12 Okay, so now we're to paragraph 77. Okay.

13 Okay, your question?

14 Q And the question is, in that sentence we
15 were discussing, it starts:

16 The output 401 transferred to a vessel
17 which contains dehydration catalyst; e.g., 206.

18 So the question is, this is teaching
19 using the dehydration catalyst we just discussed
20 in a dehydration reactor; is that correct?

21 A Yes.

22 Q And it operates at temperatures between

1 200 C and 440 C?

2 A Correct.

3 Q If we move to paragraph 78. It
4 discusses some alcohols that are available for use
5 in this reaction, including specifically 1-hexanol
6 in the first sentence. And then the second
7 sentence says:

8 In some embodiments, the 1-alcohol is an
9 alcohol of general formula, $R_1R_2CH(CH_2)_2OH$, where
10 R_1 and R_2 are independently H or a C1 to C2 alkyl
11 radical.

12 Do you see that?

13 A Uh-humh.

14 Q So this would be teaching persons
15 skilled in the art that they could use, for
16 example, 1-hexanol, e.g., dehydrate 1-hexanol
17 using this process?

18 A Yes.

19 Q And they could also dehydrate 1-octanol
20 using this process?

21 A Yes.

22 Q And the product of that dehydration

1 would be the same size alkene?

2 A Yeah, alkene would be the same size,
3 yeah.

4 Q Just to clarify, the 1-hexanol would
5 give us 1-hexene, and the 1-octanol would give us
6 1-octene?

7 A And other things.

8 I need to be clear that it says produce
9 1-alkenes. It doesn't mean it says produce only
10 1-hexene or 1-octene. That's important to know.

11 Q If we turn to paragraph 94 next. Here
12 we're discussing Catalyst 2. It was made by
13 adding .6 weight percent sodium onto an alumina
14 carrier, ActiSorb 100-1, by incipient wetness
15 impregnation.

16 Do you see that?

17 A Yeah. Yes, I do.

18 Q And then it discusses creating the
19 solution, and then afterwards the impregnated
20 carrier -- the final sentence says:

21 The impregnated carrier was then
22 calcined at 550 degrees C for 6 hours to obtain

1 the final catalyst.

2 Do you see that?

3 A Yeah, .5 grams was heated, yeah.

4 Q And so this is teaching how to create a
5 specifically modified gamma alumina catalyst that
6 is then calcined?

7 A It was assumed it was calcined, yeah.
8 But it's teaching that at that scale, 550 degrees
9 at 6 hours produced a calcined catalyst. That's
10 what it's teaching.

11 Q If we turn to Table 1, which is on the
12 following page, we see the Catalyst 2 at a weight
13 hours base velocity of .5, temperature 360, with
14 the feed 2 weight percent heptane and
15 bio-1-butanol, that we would achieve a
16 99.6 percent conversion with a 93.8 percent
17 regioselectivity.

18 Do you see that?

19 A Yes.

20 Q And so that would be teaching that the
21 dehydration reaction converts 99.6 percent of the
22 alcohol?

1 A Correct.

2 Q And that the 1-alkene selectivity is
3 93.8 percent?

4 A The 1-Butene regioselectivity. Doesn't
5 say anything about 1-alkene selectivity. This is
6 a single example of a single alcohol.

7 Okay. Just to follow up on that, you'll
8 notice that all the examples in this application
9 are butanol. All the examples given, all the data
10 given, is butanol. It's an important notation to
11 make, because it's -- I think it's clear in the
12 literature, a POSITA would look at it and go,
13 well, things don't always translate from, as we
14 are actually talking about Wu's work, 3-methyl,
15 1-butanol doesn't translate to what n-butanol will
16 do. You don't get those same results.

17 So it's clear alcohol-like branching,
18 things like this, can have an effect. I think
19 it's worthy to mention that in this. I love this
20 work. This is a big part of my life, and -- but
21 it was very limited to 1-butanol, the study of,
22 unfortunately.

1 Q And we discussed earlier that the
2 temperature for calcinations that are taught by
3 the Wright '451 patent include the range of 100 to
4 900. So would a person skilled in the art
5 understand they could calcine the impregnated
6 carrier at any temperature within that range to
7 obtain the final catalyst?

8 A Well, when one reads a range given in a
9 patent, would I assume that every temperature in
10 that range was tested? No. I would assume that
11 the writers, the inventors of the patent said this
12 is typical and we would propose that our
13 calcination would work like the previous patent,
14 the previous patent, and so we'd use the common
15 calcination temperature range, which is not -- the
16 ranges within the patent are difficult if there's
17 not an example to prove.

18 And I think just because you're talking
19 about calcination temperatures, the Inolex data,
20 which was surprising to me, in all honesty, was
21 surprising that the calcination temperature going
22 from 440 to 500 actually had a significant effect

1 on the catalyst, and therefore, one 200 to
2 600 degrees is not going to work. That was a
3 surprising result that we didn't expect.

4 And is that true for 1-butanol?

5 Butanol, you might be able to calcine it at
6 600 degrees and it works just fine.

7 Q So a person of skill in the art would
8 understand that the calcination temperature they
9 chose would depend on the alcohol they're trying
10 to dehydrate?

11 A Well, I would say that would be more of
12 an expert interpretation. A POSITA would say,
13 here's a range. How do I pick a temperature of a
14 net range would have to be a trial and error. And
15 I think, as we were, we were surprised that there
16 was a unique limit to these catalysts for
17 2-octanol -- excuse me, 1-octanol.

18 So I think it's, a POSITA would, you
19 know, as sort of a working range, but understand
20 that depending on the scale of the catalyst prep,
21 the type of promoter that one was using, and
22 because not all promoters are going to decompose

1 and calicine at the same temperature. So there's
2 variables.

3 I think a POSITA would go, unless
4 there's a specific method of preparation for the
5 scale that we're operating at and with the exact
6 promoter that we're operating at, they wouldn't
7 know where to go. It would be simply a trial and
8 error.

9 If I could add on to that, Ryan, because
10 it -- we know if you went up to even 500 degrees,
11 the catalyst couldn't give that kind of
12 performance and selectivity. In fact, it dropped
13 down from those numbers.

14 And so it -- you know, if you look at
15 the Inolex published in the patent specification,
16 we know that range, that exact prep of that
17 catalyst will not work for octanol, but it did
18 work for butanol. This is a direct correlation.
19 Here's a result for octanol. Here's a result for
20 butanol. They're not the same. You can't take
21 this work and say you can translate it to
22 1-octanol, which is, in my opinion, and when I

1 went to work and consulted with Inolex, was
2 unexpected. I thought I could walk in there and
3 use the Navy work.

4 And of course, you haven't mentioned,
5 not a problem, of course, you haven't mentioned
6 silanization. But this World patent that you talk
7 about, that we're talking about now is, in fact
8 proves silanization, kept time-on-stream longer
9 and so on, there's other factors with this patent
10 that were critical.

11 And again, I wouldn't have expected the
12 Inolex catalyst to last for the time-on-stream
13 that it did. It was unexpected based on this Wu
14 patent. In fact, the data shows that without
15 silanization, there's a deactivation over time,
16 and you would not expect it to last 1400 days --
17 1400 hours, excuse me.

18 Q But there are specific examples in here
19 where you don't rely on silanization and still
20 achieve, you know, these results; is that right?

21 A They were prepared as comparative
22 examples and they were run over shorter times, and

1 some that were run over longer times. I'm not
2 sure if the data is in, but the performance fell
3 off with time-on-stream, and so they were deemed
4 as deficient catalysts compared to the silanized
5 catalysts.

6 So this patent, to teach anything that I
7 would call works, or you would enable, it was that
8 silanization is the way to make a catalyst
9 commercially viable because you can have
10 time-on-stream for 1-butanol. It quotes a lot of
11 alcohols. All the data was for 1-butanol. And I
12 think we saw from Inolex's work the unexpected
13 result, that you can't just calcine at
14 500 degrees or 550 and get catalyst performance.

15 And what's surprising is you can get --
16 without silanization, you can get a
17 time-on-stream. It's very long, much longer than
18 anything the literature -- in fact, it counters
19 what a POSITA would expect in the literature.
20 It's clear, unequivocally clear time-on-stream
21 decreases selectivity and conversion over time. I
22 think there's -- probably all parties could agree

1 there's enough data out there and results, and
2 it's what inspired me to do silanization, which is
3 ironic because the De Bruyn people claim that
4 silanization, or silicon adding to the catalyst,
5 decreased its selectivity, and we showed that it
6 actually didn't affect the selectivity and
7 increased its time-on-stream.

8 So there was, you know, there's -- it's
9 clear number of, the number of carbons in the
10 alcohol is significant in how you interpret the
11 results of previous data. It's -- I like it
12 because there's still surprises out there.

13 Q But I guess, just to wrap this up, like,
14 for example, Catalyst 2 that we walked through
15 achieved these results without the silanization
16 step in Table 1?

17 A Table 1, yeah, unequivocal. I will --
18 for 1-butanol. I just want to put that constraint
19 on it, that it's 1-butanol and it was one run.
20 And there's no time-on-stream given for this
21 catalyst. I don't think we talked about the spec,
22 but we ran time-on-stream experiments and watched

1 it degrade.

2 I think -- I used to joke about it at
3 the -- I mean when I started working with Clariant
4 on this. When I was at Cobalt Technologies,
5 Clariant looked at my silanization and went
6 poo-poo, we don't need that stuff. It was a
7 battle to get them to engage and utilize
8 silanization.

9 And unequivocally, at the end of the
10 day, that was the catalyst that went off to
11 commercialization studies, was a silanized
12 catalyst, not Catalyst 2, because of the
13 performance of time-on-stream and so on.

14 So, you know, yes, can this jump out of
15 the box like -- I think I would admit, you know,
16 you look at De Bruyn examples, you can take an
17 alumina catalyst and get some pretty good numbers,
18 but they don't hold up and, as you start running
19 day after day after day, and it's critical for
20 commercial catalysts.

21 You can argue, is it six months, is it
22 two months, is it four months? But nobody wants

1 to be shutting down, load up the reactor,
2 switching reactors, get a crew to unload three
3 metric tons of catalysts weekly, so ...

4 Q So if we were not worried about
5 time-on-stream, is there any advantage to
6 including the silanization?

7 A Well, if you were going to run a single
8 batch, I think you could, it would be a fair
9 statement to say silanization for a five-minute
10 run and looking at those numbers, if there's an
11 advantage it's one percent or something like that.
12 I think we saw little higher numbers with the
13 silanization, but it was, you know, you went to --
14 you know, you'd see a percent or two change. I'd
15 have to go back and find the table here, Ryan.

16 I have to admit I sort of looked at
17 this. I knew this was coming. It's no surprise.
18 This has been out in the literature. You can find
19 it on Google. So I knew this would come up.
20 Well, gee, this has already been invented. Well,
21 it really hasn't because it gives you
22 specifications which just don't work. And you

1 can't operate in that range of 200 to 600 degrees,
2 and the amount of loading of calcium is different,
3 and so on, so on.

4 I'd have to look back, but -- we
5 explored different calcium loadings, but I'm not
6 sure, I have to be careful, I -- I'd have to take
7 the Inolex patent and look at this exactly and see
8 if we loaded it exactly the same calcium loading,
9 but I don't think so. I think Inolex was a bit
10 higher.

11 Q By "calcium loading," do you mean the
12 method of loading it, or the --

13 A No, the amount of calcium.

14 So I mean if you're comparing apples to
15 apples with this, with this catalyst work and the
16 Inolex work, it might show another shortcoming
17 that this work that was published, or was, you
18 know, in a patent application doesn't translate to
19 octanol.

20 Q Well, if you look at Example 12, just to
21 choose one that actually has calcium on there,
22 says, it says, which is paragraph 104, it says:

1 This invention Catalyst 12 was made by
2 adding one weight percent calcium onto alumina by
3 the incipient wetness impregnation.

4 So is the one percent calcium an
5 acceptable amount of promoter to include in that
6 catalyst?

7 A For 1-butanol, for this example, yes, by
8 weight. Essentially that's the -- if you look at
9 that, it's -- you're not adding one percent weight
10 percent of calcium acetate, but you're adding
11 enough calcium acetate that you assume after the
12 calcium acetate goes away and you're left with
13 calcium oxide, that's the weight percent left on
14 the catalyst.

15 This was sort of a comparative example
16 that we prepared. That's why these examples were
17 prepared, for comparison to the silanization.

18 Q Just to finalize this point, can we look
19 at Table 2, which is page 31.

20 So here we have the results of the
21 Example 12 which says under the WHSV of 1.26 and
22 temperature at 360 degrees C, we get a conversion

1 of 98.8 and selectivity of 96.4; is that right?

2 A Yeah. Yeah.

3 Q And you think that this, or is it your
4 opinion that this catalyst would not work for
5 octanol, for example?

6 A Well, would it work and dehydrate and
7 generate alkenes? Yes, I think it would generate
8 alkenes. And -- I mean the examples you give,
9 looking at that line 12, it says, aging time zero
10 hours.

11 So keep in mind, this is a fresh
12 catalyst, first-time-through result, within five
13 minutes of collecting alkene and coming out.

14 Do I think, you know, promoting an
15 alumina catalyst with lots of promoters is going
16 to take octanol to octene and 2-octene and octyl
17 ether and so on? Yes, you're going to get some
18 array of products. Would it stand a good shot of
19 high selectivity for a short period of time?

20 Yeah, it might.

21 My POSITA would say, well, it worked for
22 butanol, it should work for octanol, much like my

1 Navy work. Like it worked for butanol, it should
2 work for octanol. Well, it didn't.

3 And, you know, we saw gamma alumina
4 straight out of the box, no modification, didn't
5 give numbers that would relate to what Wu saw. So
6 we were very diligent to look at the past, and of
7 course, me walking into the room in Inolex brought
8 a lot of, as evidenced by this document, a lot of
9 experience in alcohol dehydrations.

10 MR. MURPHY: We're at a pretty good
11 break point if that's --

12 MR. LUKAS: Sure.

13 (A recess was taken at 12:38 p.m.)

14 AFTERNOON SESSION (1:18 p.m.)

15 BY MR. MURPHY:

16 Q All right. Dr. Wright, can we start
17 with looking at Exhibit 1001, which is the '048
18 patent.

19 A Which patent?

20 Q The '048 patent.

21 We talked about some of this before, but
22 I just wanted to discuss in the context of what's

1 disclosed in the '048 patent.

2 So can we turn to column 8. Talk about
3 the paragraph that's around line 32 to 45.

4 A Okay. Got it.

5 Q All right. You'll see -- I think it's
6 going to be the third sentence there where it
7 says:

8 The base may comprise a Group I or a
9 Group II metal.

10 A I guess I wasn't -- I'm sorry, you said
11 column ...

12 Q Column 8, and then the paragraph starts
13 around line 33, and we're looking at line 35.

14 A Okay, line 35. Okay, I'm -- yeah,
15 right.

16 Q And we talked a little bit about this
17 before, but what would a person skilled in the art
18 understand, from the Group I or Group II metals
19 which ones can be used as a base to modify the
20 gamma alumina catalyst?

21 A I guess I'm wondering -- I mean are you
22 asking me to go on the Periodic Table and talk

1 about Group I and Group II? You know, essentially
2 talking about --

3 Q Maybe it's easier to ask, are there any
4 Group I or Group II metals that would not work as
5 a base to modify a gamma alumina catalyst?

6 A Not having tested all of them, but
7 inherently I would say Group I or Group II, they
8 would all work, to some level. All equivalent?
9 No. Possibly, that's a yeah. But I would not --
10 just based on the chemistry, you can go down the
11 group, you should find similar behavior. Other
12 kinetics and lots of things change, but you expect
13 similar behavior.

14 Q Then would you expect, for example, the
15 calcination temperature to change as you go down a
16 group?

17 A Calcination is a combination of kinetics
18 and thermodynamics, and it would depend on what
19 was attached to the Group I or Group II because,
20 remember, it's chemistry. So, you know, are you
21 using sodium carbonate, or sodium acetate, and
22 those could calcine. Those calcination

1 temperatures could be different. You may want to
2 calcine one longer, shorter than the other to
3 actually get the same effect of catalyst.

4 Q Would the temperatures change, or just
5 the time change for the calcination?

6 A I simply can't say, but I would argue
7 that both could change. I think it's much like we
8 were talking about, you know, the flow rate and
9 the temperatures. Like you could go perhaps at a
10 lower temperature for a longer period of time, but
11 in some ways, there are certain kinetic barriers
12 that you have to get over. And going at that
13 lower temperature might not get you over that
14 kinetic barrier to actually get the true
15 calcination reaction to occur. It's a little bit
16 of kinetics and thermodynamics.

17 And, you know, so it's difficult to say.
18 Could you just go longer because you went at a
19 lower temperature, you know, or if you go at a
20 higher temperature, can I go for a shorter time?
21 Would that give me a similar product?

22 I think that's where specificity, in

1 terms of the teachings, in terms of the examples
2 given to show calcination works or the catalyst
3 works is critical.

4 Q If we go a little bit further down in
5 that same paragraph, it would be right around line
6 39 of column 8.

7 A Okay.

8 Q It says:

9 In one embodiment, wherein the calcium
10 promoter is used, the calcium promoter may be used
11 in an amount of --

12 (Court Reporter clarification.)

13 Q I'll start the question again.

14 So we're looking at column 8, around
15 line 39, and it says:

16 In one embodiment, wherein a calcium
17 promoter is used, the calcium promoter may be used
18 in an amount of about .01 weight percent to about
19 4 weight percent based on the weight of the CaO
20 determined after calcination.

21 Do you see that?

22 A Yes. Yes.

1 Q What impact does changing the weight
2 percent of the calcium promoter in this case have
3 on the dehydration reaction?

4 A It can change the corrosion rate, and it
5 can change the selectivity. The sensitivity to
6 those changes, my POSITA hat on, would probably be
7 variable and potentially, you know, unexpected, or
8 hard to predict, excuse me, not unexpected, hard
9 to predict, depending on the alcohol that's being
10 dehydrated.

11 It could have a different -- and I think
12 I would base that on the literature examples we've
13 looked at where people have done promotion,
14 promotion additives. And, of course, they've
15 often been very sloppy about telling how much they
16 promoted with in terms of weight percent. But I
17 think my experience would say, as a POSITA, that
18 it would be difficult to know exactly where in
19 that range I should be for this alcohol to get
20 this conversion.

21 Q And then would you expect each of the
22 Group I and Group II metals that we just discussed

1 to work in a similar weight range that's provided
2 here for calcium?

3 A I would say no, in part just because the
4 molecular weight -- actually, I should say atomic
5 weight of the Group I or Group II metals changes
6 significantly as you go down the column. So if
7 you're talking about active sites generated by,
8 you know, one gram of sodium versus, you know, one
9 gram of barium or -- the atomic weight is so
10 different that would create a very different
11 number of sites or blocking sites capabilities.

12 So I would not take a, just a weight
13 percent and assume I could go down a group and see
14 similar loading levels would work. I would not
15 make that assumption as a practicing POSITA.

16 Q Would a .01 weight percent promote a
17 catalyst for any of the Group I or Group II
18 metals?

19 A Well, I can put on my science hat and
20 say it's possible. Would it be likely? No.

21 Q Is there some minimum weight percent
22 that you would probably try as a person skilled in

1 the art?

2 A Well, if I was reading this paper, I
3 would look at their preferred range, which sort of
4 gets you very closer to what actually worked in
5 the patent. You know, my experience would say, I
6 would shoot for the preferred range. I wouldn't
7 even bother with the extreme ranges. I think, you
8 know, often in patents those teachings are -- they
9 are potentially valid, but probably likely not
10 proven.

11 Q I guess to take your example with
12 bariums, you know, larger, would you expect that
13 to work at a like 4 weight percent of the
14 catalyst?

15 A Predictively it very well could. I
16 don't know if I would want to use that much
17 barium, but yes, you know, could it -- is higher
18 better? Could it give you the selectivity that
19 you want?

20 As I mentioned, you can have too much of
21 a good thing. Just putting in more promoter, my
22 experience is -- this is more my expert hat --

1 more promoter is not necessarily beneficial.

2 And in fact, there is a bit of a bell
3 curve to these promoters in terms of optimum
4 conversion. Is that bell curve the same for this
5 alcohol versus that alcohol, that promoter versus
6 that promoter? I don't have a good answer for
7 that.

8 My prediction would be, based on what
9 I've seen in my own work, the answer would be no.
10 That depending on the alcohol, depending on the
11 promoter, one would have to investigate that and
12 find out if there is a correlation or if a
13 promoter is even a promoter that promotes
14 selectivity and reaction, because, let's face it,
15 your promoter is not just -- this is not
16 advertising, we're not like we, it has to promote
17 something you're looking for.

18 Ideally, in our case, I think what's
19 involved in this deposition is selectivity and
20 conversion, you know, those two things. I mean if
21 it doesn't promote conversion and retain very high
22 selectivity, it wouldn't be a promoter.

1 Q Then I guess we can say the same thing
2 for, for example, like the other ones listed would
3 be potassium or sodium the '048 lists as potential
4 use cases. Is that the same thing, it wouldn't be
5 predictable which ones would work at what weight
6 percentage, you'd have to run the experiment?

7 A I think you could -- you know, we talk
8 about there's perhaps typical ranges that you
9 would shoot for. I think if you look at most of
10 the literature examples that are out there, that
11 you can find where they actually tell you how much
12 promoter. You know, this Clariant/Wright patent,
13 1039, gave out very specific loading levels and,
14 et cetera. You find that occasionally in the
15 catalysis business, but I think there are ranges
16 that you would tend to migrate toward.

17 Would I start at 10 percent? I'm not
18 sure. You know, what's interesting when you ask
19 that question is like you go back to the Wu patent
20 and they washed it with 30 percent potassium
21 hydroxide. How much potassium was left on the
22 alumina, and what was their loading level that

1 they claimed to have a great catalyst? It could
2 have been 20, it could have been 20 percent
3 potassium for all I know.

4 But where I've taken and seen examples
5 that actually give us loading levels, it's usually
6 something more modest, in the ranges that you saw
7 of course represented in the Inolex patent,
8 10,995,048; just trying to help you out in terms
9 of being specific, because they, obviously Inolex
10 has more than one patent in the world, so ...

11 Q I guess I'll refer back to something you
12 said earlier today that, you know, without the
13 experimental data, it's difficult to kind of
14 understand exactly how these different things
15 interact. And so for the '048 patent itself, it
16 seems like all the experiments are largely based
17 on a calcium promoter.

18 So would you, based on the experiments
19 provided, you know, in the '048 patent, would you
20 be able to extrapolate that beyond calcium to
21 other promoters?

22 A Oh, I think, much like my previous

1 patents and other patents in the area, you would
2 think the other base-type promoters would work.
3 Would they work as well as the calcium? I would
4 not want to have to predict that.

5 If I was, again, working at a company as
6 a POSITA, I walk into my boss' office. He says,
7 hey, I want you to use this promoter. It's not
8 the calcium that we're using, but I want to obtain
9 every bit of yield in conversion and selectivity.
10 If it doesn't work, you're fired. I would be
11 looking for another job pretty quick. I wouldn't
12 be convinced that I could produce it with barium.
13 You might, but you might not.

14 Q So you say there's no way to tell if
15 you'd be able to consistently achieve the
16 95 percent conversion that you get with calcium
17 when you use sodium, for example?

18 A Yeah. Yes, I should say. You know,
19 there's -- you can sit there and say, you know,
20 that you would expect these metals to, these Group
21 I, Group II metals to act as promoters, and would
22 they give you the exact numbers that you see in

1 your examples that you gave in your patent? It's
2 probably unlikely you'd see the exact numbers.

3 I can't recall, and I'm not going to try
4 and quote you numbers, but I have seen papers
5 where people use different promoters and there
6 often are small differences, you know. When
7 you're talking about commercial processes like
8 this, one percent selectivity is a small
9 difference, but it makes a difference between
10 commercialization or not.

11 And so when I look at these patents,
12 when I looked at the Inolex patent at one point
13 and the Cobalt patents and my Navy patent, you
14 know, you have to look at the process and the
15 alcohol and the feedstock, and decide how easy it
16 is to separate things, and what is an okay drop in
17 selectivity using a different promoter, if it's
18 cheaper, more safe, if it lasts longer, things
19 like this, factors like that.

20 Q Okay. If we turn to column 17 of the
21 '048 patent.

22 A Okay.

1 Q I was going to ask you to look at around
2 the paragraph that starts around line 13, column
3 17.

4 A Okay. The gamma alumina may be
5 provided?

6 Q Yeah. And I was going to ask you to
7 look at the final sentence, right around line 20.
8 Basically it says, you know, the shape of
9 the extrudate can be three-dimensional. They can
10 ultimately deliver gamma alumina with sufficient
11 surface area, pore volume, mechanical strength and
12 physical size to be used in a continuous flow
13 reactor.

14 Do you see that?

15 A Yes.

16 Q What is the surface area, pore volume a
17 reference to?

18 A It's reference to the gamma alumina
19 structure itself, which is dictated by the
20 starting alumina that you use to create your
21 catalyst.

22 So, you know, things like pore volume,

1 essentially, is the size of the pores, and so is
2 it 6 nanometers, or 10 nanometers or so on. And,
3 you know, its mechanical strength, and so on.

4 So I think this was just saying that,
5 you know, you can use multiple, and I think
6 different, I think you might have said, that have
7 sufficient, it's with sufficient surface area,
8 pore volume.

9 So what we're talking about is you can
10 have different shaped structures, whether they're
11 cylinders or trilobes or whatever, as long as they
12 have the pore size and they're made from the
13 alumina, gamma alumina that has the requisite
14 starting properties, and those properties being
15 surface area, pore volume and things.

16 When you look at a catalyst like this, a
17 gamma alumina, they all are made and prepared as
18 powders. They aren't prepared as cylinders or
19 trilobes. So to prepare as a powder, it has
20 certain properties, and then they compress it into
21 a shape with sometimes a small amount of adhesive
22 or something like that, and then that creates a

1 shape that is actually put into the reactor. And
2 that shape is dependent upon the mechanical
3 strength you need, and so on.

4 But the reaction, or reactivity of the
5 catalyst, that's what this is, the reactivity of
6 the catalyst is not dependent upon whether it's a
7 trilobe or a cylinder or the length-to-diameter
8 ratio is this or that. It's saying it's really
9 controlled by the surface area, pore size,
10 promoter, gamma alumina structure, things like
11 that.

12 Q If you wanted to replicate an experiment
13 using a gamma alumina catalyst, would you need to
14 know the surface area, pore volume of the catalyst
15 before doing the experiment?

16 A It would be very, very helpful, yeah, to
17 have an idea of what sort of range of pore and,
18 but I would just argue that it would be a range
19 rather than a specific number.

20 But yeah, you would like to know -- the
21 shape is less relevant than -- the shape of the
22 extrudate is less important than the, like I said,

1 the pore and surface area.

2 Q And would the commercial name of the
3 catalyst necessarily indicate what the surface
4 area, pore volume is?

5 A No.

6 Q So we could get two batches ordered from
7 the same manufacturer, effectively, and have
8 different pore volumes?

9 A Now that's a different question, because
10 manufacturers, when they have a trade name of a --
11 you could -- take some that were in these patents.
12 That trade name has a specification of pore size
13 and surface area and so on.

14 So inherently, if they're producing
15 within their production specs, they're going to be
16 somewhere within a window. Usually like alumina,
17 they don't give an exact number. They'll talk
18 surface area between 150 and 200 meters per gram,
19 something like that.

20 If it doesn't fall within that range,
21 then the manufacturers let you down. You need to
22 go call them up and go -- if you figure out that

1 your catalyst doesn't actually work and you go,
2 something's wrong here. Could you get a bad
3 catalyst batch? Yes.

4 But in general, you would expect them to
5 be performing within their production metric, and,
6 you know, whether you bought it from Evonik or
7 Clariant or some of the gamma alumina producers,
8 quickly open up their spec sheet and says, this
9 needs to meet criteria.

10 Q Is it common to measure that in a
11 catalyst prior to using it in a reaction?

12 A If I was a POSITA at a company and I was
13 buying 10 metric tons of that material, I would
14 first tell the company to send me over a small
15 sample before they would deliver me this 10 metric
16 tons, and I would confirm it by sending it out to
17 a lab.

18 Very few catalysts or production
19 facilities have the capability, but measuring that
20 on a contract basis to confirm that can be done.
21 If you trust your manufacturer, you're dealing
22 with smaller quantities, would I send it out to

1 verify? Probably not, you know. But before I was
2 to set up a large reactor in a commercial process,
3 I would certainly make sure it was the right pore
4 size and they have modified the right gamma
5 alumina.

6 Q And then can you have similar pore sizes
7 with different activity levels in the same gamma
8 alumina catalyst?

9 A Well, activity level is -- I don't
10 really necessarily use that term. In all honesty,
11 the only time I've ever used activity levels is
12 to, for chromatography applications where alumina,
13 gamma alumina or alpha alumina, usually it's alpha
14 alumina, is ranked as activity 1, 2, or 3, and
15 that depends on the water content of the alumina.

16 Normally, and you might have been
17 thinking, forgive me if I went off-track, you
18 might be thinking reactivity, or activity in terms
19 of catalytic performance. But if you just use the
20 term alumina activity, the chemist in me goes back
21 and says, okay, I aluminum 1, 2 and 3, and I know
22 how to make it. You know, you start with activity

1 at 2 grams per 100 grams of alumina, and you get
2 to activity 2. You add two more grams, you get
3 activity 3. I think I went off-track.

4 Q I guess we can clarify that and say, if
5 we use your suggestion of reactivity of the gamma
6 alumina catalyst, is that something that, where
7 you can have different reactivities of the
8 catalyst even though they have a similar pore size
9 and distribution?

10 A That's a difficult direct correlation to
11 give you because pore size is probably less
12 important than surface area. Pore size, and it's,
13 in all honesty, not relevant to this work that
14 I've seen or found, is that that controls geometry
15 of what can fit inside the pore or not. And in
16 general, all the pore sizes that we're talking
17 about, and in really all these patents that I
18 think we've discussed today, the pore size is
19 large compared to the molecule. So access through
20 the alumina is not a critical issue, and so it's
21 strictly a surface area and reactive sites on the
22 alumina.

1 Q I guess we can ask that question next.
2 Can we have the same, you know, product from
3 manufacturer, we've ordered it, and have different
4 surface area for the catalyst?

5 A Well, you, again, you would expect them
6 to be within their specs, and I -- is it possible
7 when they prep the catalyst that the pore size was
8 incorrect? Yes. But they also have to go through
9 some checks. And you can, any time you're in
10 manufacturing, I think any POSITA would say, give
11 me a certification of manufacturing, and that
12 would have a test that they ran that says, I've
13 shipped you this alumina and here is the measured
14 pore volume, here is the measured surface area.
15 And again, I would expect to see that before I
16 would assume it's the same, especially in a
17 commercial operation.

18 You know, did all my students do that at
19 the university? I don't think we were quite as
20 vigorous as we might have been, should have been
21 sometimes, in all honesty. Sometimes not getting
22 a re-agent spec can really bite you, yeah, and

1 cost you a lot of time, and money, so ...

2 Q Look a little further down in column 17,
3 around line 49, where it says:

4 Bio-1-alcohol is preferably fed, such as
5 by a pump (such as an HPLC pump) or pressurized
6 gas source at a temperature of about 200 degrees C
7 to about 400 degrees C.

8 Do you see that?

9 A Yes.

10 Q I think most of what we've been talking
11 about so far has been the use of a HPLC pump, but
12 here it's also listed as a pressurized gas source.

13 How would that alter the reaction, the
14 dehydration reaction?

15 A Well, I guess, first of all, it doesn't
16 imply that there's a purge gas going through the
17 reactor. I think, I read that, maybe this is
18 incorrect, but I read it as basically you're
19 creating a way to push the alcohol from one
20 location to another through a tube, and whether
21 you do that with a piston or a gas pushing a
22 liquid, that doesn't imply that you're supplying a

1 purge gas.

2 So my interpretation of that would be
3 that that's exactly the same as if you pumped it.
4 That I take this as you're putting a liquid into
5 the reactor under both circumstances.

6 Would the alcohol absorb some of that
7 gas? Likely. But we're not using degassed
8 alcohols when we -- for instance, when you're
9 using an HPLC pump, we didn't degas the solvents
10 or the alcohol with helium. We put it in fully
11 absorbed with oxygen and nitrogen from the
12 atmosphere. So we were never using degassed.

13 And these alcohols can only absorb so
14 much gas anyway, 30 psi. It might be a little
15 higher, but that's not going to be significant in
16 a reactor one would think. But I think that was
17 implying it's just a different way to push your --

18 Q So in your opinion, they're basically
19 interchangeable for the purpose of the
20 dehydration reaction?

21 A Yeah, the way I read that, and I think I
22 mentioned before, and this is putting on the

1 expert hat, we looked at utilizing purged gases
2 and it was not a way to get a benefit in our case,
3 for 1-butanol. Again in specific, I have to be
4 specific to 1-butanol because that's what I had
5 done most of my work on prior to Inolex.

6 Purge gases are dilution. You just
7 simply then change the selectivity or
8 time-on-stream. It was not -- didn't really hurt
9 us, didn't really help us.

10 Q So are you always introducing the
11 alcohol into the reactor as a liquid; is that what
12 you said?

13 A All I can say is most of the work was
14 done that way. I can go back to my Cobalt work
15 when the 1-butanol, we looked at vaporizing the
16 alcohol ahead of time and there was no benefit to
17 that. And I think I'd have to, because I don't
18 want to try to do it off memory, but in general,
19 my experience, I'll say it as a POSITA would say,
20 that the introduction of the alcohol, whether it's
21 a gas or a liquid, will only depend on how much in
22 your reaction chamber do you use to heat the

1 material up. Because I had, one thing that's
2 important to understand on this chemistry is that
3 bad things don't happen when there's very little
4 reaction. It only happens when you've reacted and
5 you're still heating.

6 And so in general, you look at this
7 chemistry, injecting and on, and it's not doing
8 anything, and it's getting heated up, aren't bad
9 thing going to happen? And my experience is that
10 bad things don't happen at the beginning of the
11 reactor, they happen as you go later on in the
12 reactor, you start getting isomerization.

13 And so the front of the reactor, even
14 though you're cooling it or potentially having
15 some cooler spots and vaporizing the alcohol, it
16 doesn't seem to, to cause any deleterious or
17 negative reactions whatsoever that I've ever seen
18 in my experience.

19 Q And would you always want to vaporize
20 the alcohol during the reaction process?

21 A No. It's sixes. You can vaporize it
22 before without any consequence. You have an extra

1 heater, you have an extra vessel, you can load it
2 with silicon carbide and their packing material,
3 and you'll see that in some patents, you'll see
4 that in some reactors where they vaporize first.

5 I think that depends on your catalyst.
6 And I would argue that the Inolex catalyst, and in
7 fact back to the Navy catalyst with the
8 silanization, we didn't see any detrimental
9 effects on the catalyst with time-on-stream, which
10 was, you know, in all honesty, that was always the
11 metric that we -- it wasn't what happened in the
12 first few minutes. It's like if we do this for,
13 hour after hour, what's the consequence of
14 introducing this liquid?

15 And you can imagine, whether it's
16 octanol or hexanol, if you have water in the
17 alcohol, introducing water, liquid water to
18 alumina can be potentially very detrimental.

19 Our silanization work that we found with
20 the Navy with the butanol, there were times that
21 the butanol feed stopped and we were injecting
22 straight water on the column and we still didn't

1 ruin our catalyst. The other alcohol started
2 coming back on stream, and we got back in
3 business.

4 So it's very dependent on your catalyst
5 and how you've prepared it. And I think alumina
6 in general is pretty doggone resilient.

7 Q I guess asking a slightly different
8 question, would you ever leave the alcohol in the
9 liquid phase throughout the entirety of the
10 reaction?

11 A I mean my POSITA view on that would be,
12 gee, I've never seen anybody do that. I wouldn't
13 have any precedence to say that it would be okay.
14 Especially, I think it would depend on the water
15 content and contaminants, because it's always not
16 just the reaction you think you're putting on
17 there, but it's the other contaminants that are
18 coming in that can do damage to your catalyst or
19 change the reactivity of your catalyst.

20 So it's a, it's a fair question, but I
21 -- my gut feeling as a POSITA would be like this
22 could be really risky.

1 Q And would you expect the gamma alumina
2 catalysts that we've been discussing to work
3 similarly well and achieve the similar conversions
4 if the alcohol was left in a liquid phase?

5 A That's a, that's a proposed reaction
6 condition that I just, I can't comment on because
7 that would be, you're inferring you're going to be
8 at 350 degrees at such a pressure that the alcohol
9 is in the liquid phase, right? Because if you're
10 truly at 350 degrees, then you've got to be under
11 significant pressure. So if I'm going to go
12 through this whole reactor and keep it in the gas
13 phase, I'm going to have to be at a pressure
14 that's going to keep the alcohol liquified.

15 Q Or I guess if you had like longer chains
16 that end up being liquid at higher temperatures --

17 A Yeah, yeah. If you were putting
18 hexadecanol through a 16-carbon alcohol through
19 there, I can't say I've seen a patent, or even I
20 think a paper on putting through, a liquid
21 hexadecanol through an alumina column.

22 My gut feeling is, my expert opinion is

1 it would be worth a try, but I would not be able
2 to predict it. As a POSITA, I definitely would
3 not go in there and assume that everything would
4 be okay.

5 MR. MURPHY: Go off the record.

6 (A discussion was held off the record.)

7 MR. MURPHY: That's all of my questions.
8 Pass the witness.

9 MR. LUKAS: I do not have any questions
10 for the witness. Thank you for your time,
11 Dr. Wright.

12 MR. MURPHY: Thank you, Dr. Wright.

13 THE WITNESS: Thank you.

14 (Off the record at 1:55 p.m.)
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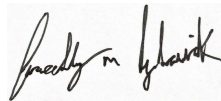
CERTIFICATE OF NOTARY PUBLIC

I, Brad Sydorick, the officer before whom the witness was sworn, do hereby certify that the witness was sworn/affirmed to tell the truth, the whole truth and nothing but the truth; and that I am neither counsel for, related to, nor employed by any of the parties to this case and have no interest, financial or otherwise, in its outcome.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 23rd day of April, 2024.

My commission expires:

September 11, 2027



NOTARY IN AND FOR THE
COMMONWEALTH OF PENNSYLVANIA

1 CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC

2 I, Dawn M. Hart, Certified Reporter and
3 Notary Public within and for the State of
4 Maryland do hereby certify:

5 That Michael E. Wright, Ph.D., the witness
6 whose deposition is hereinbefore set forth, was
7 duly sworn by a Notary for the Commonwealth of
8 Pennsylvania before the commencement of such
9 deposition, and that such deposition was taken
10 before me and is a true record of the testimony
11 given by such witness.

12 I further certify that the adverse party,
13 Isolex Investment Corporation, was represented by
14 counsel at the deposition.

15 I further certify that the deposition of
16 Michael E. Wright, Ph.D., occurred on Tuesday,
17 April 23, 2024, commencing at 9:33 a.m. to
18 1:55 p.m.

19 I further certify the inspection, reading
20 and signing of said deposition was not discussed
21 on the record.
22

1 I further certify that I am not related to
2 any of the parties to this action by blood or
3 marriage, I am not employed by or an attorney to
4 any of the parties to this action, and that I am
5 in no way interested, financially or otherwise, in
6 the outcome of this matter.

7 IN WITNESS WHEREOF, I have hereunto set my
8 hand this 25th day of April, 2024.

9 My commission expires:

10 January 2, 2025

11
12
13 

14 NOTARY PUBLIC IN AND FOR THE
15 STATE OF MARYLAND

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