
UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PROLIME AGRICULTURAL LLC and
CAUDILL SEED AND WAREHOUSE CO., INC.
Petitioners

v.

SUL4R-PLUS, LLC
Patent Owner.

Inter Partes Review No. TBD
Patent No. 9,873,638

DECLARATION OF BRYAN J. ENNIS, Ph.D

TABLE OF CONTENTS

EDUCATION AND EXPERIENCE	7
MATERIALS CONSIDERED	10
LEGAL PRINCIPLES	12
A. Person Having Ordinary Skill in the Art (“POSA”).....	12
B. The Prior Art	13
C. Claim Construction	13
D. Anticipation	14
E. Obviousness	14
TECHNICAL BACKGROUND.....	17
THE ‘638 PATENT	19
A. Main Features of the Claims.....	20
1. Synthetic Gypsum	20
2. Lignosulfonate Binder	21
3. Particle Size	22
4. Crush Strength	24
B. Prosecution History	25
SCOPE AND CONTENT OF THE PRIOR ART	25
A. Harrison (Exhibit 1005).....	25
B. Anderson (Exhibit 1006)	27
C. Pietsch (Exhibit 1003)	27
D. Veverka (Ex. 1007).....	28
E. Shimada (Ex. 1008)	28
F. Zanuccoli (Ex. 1010).....	29
ANALYSIS OF UNPATENTABILITY OF THE ‘638 PATENT.....	30
GROUND 1 – ANTICIPATION BY HARRISON	30
A. Claim 1	30
1. Preamble	31

2. Element 1a.....	31
3. Element 1b.....	32
4. Element 1c.....	34
5. Element 1d.....	35
B. Claim 11	36
1. Preamble.....	36
2. Element 11a.....	36
3. Element 11b.....	36
4. Element 11c.....	37
5. Element 11d.....	37
C. Claim 2	37
D. Claims 3 and 12	39
E. Claims 5 and 14	39
F. Claim 9	40
G. Claim 10	40
GROUND 2 – OBVIOUSNESS OVER HARRISON	40
A. Claim 1	40
1. Preamble.....	40
2. Element 1a.....	41
3. Element 1b.....	41
4. Element 1c.....	42
5. Element 1d.....	44
B. Claim 11	45
1. Preamble.....	45
2. Element 11a.....	45
3. Element 11b.....	45
4. Element 11c.....	46
5. Element 11d.....	46
C. Claim 2	46

D. Claims 3 and 12	48
E. Claims 5 and 14	48
F. Claims 7 and 16	48
G. Claim 9	49
H. Claim 10	49
GROUND 3 – OBVIOUSNESS OVER ANDERSON IN VIEW OF PIETSCH...	49
A. Claim 1	49
1. Preamble	49
2. Element 1a	49
3. Element 1b	52
4. Element 1c	54
5. Element 1d	54
B. Claim 11	54
1. Preamble	54
2. Element 11a	54
3. Element 11b	55
4. Element 11c	55
5. Element 11d	56
C. Claim 2	56
D. Claims 3 and 12	57
E. Claim 8	57
F. Claim 9	57
G. Claim 10	57
GROUND 4 – OBVIOUSNESS OVER VEVERKA IN VIEW OF HARRISON OR PIETSCH.....	57
A. Claim 1	58
1. Preamble	58
2. Element 1a	58
3. Element 1b	63

4. Element 1c	64
5. Element 1d.....	64
B. Claim 11	65
1. Preamble.....	65
2. Element 11a.....	65
3. Element 11b.....	65
4. Element 11c.....	65
5. Element 11d.....	66
C. Claim 17	66
1. Preamble.....	66
2. Element 17a.....	67
3. Element 17b.....	69
4. Element 17c.....	70
5. Element 17d.....	70
6. Element 17e.....	71
7. Element 17f.....	71
D. Claims 2 and 19	71
E. Claims 3 and 12	72
F. Claims 5 and 14	72
G. Claims 7, 16, and 22	73
H. Claim 8	74
I. Claims 10 and 23	74
J. Claim 18	74
GROUND 5 – OBVIOUSNESS OVER SHIMADA IN VIEW OF HARRISON OR VEVERKA	76
A. Claim 1	76
1. Preamble.....	76
2. Element 1a.....	77
3. Element 1b.....	77

4. Element 1c	79
5. Element 1d.....	80
B. Claim 11	80
1. Preamble	80
2. Element 11a.....	80
3. Element 11b.....	81
4. Element 11c.....	81
5. Element 11d.....	81
C. Claim 2	82
D. Claims 3 and 12	83
E. Claims 4 and 13	83
F. Claims 5 and 14	83
G. Claims 7 and 16	86
H. Claim 9	87
I. Claim 10	87
GROUND 6 – OBVIOUS IN FURTHER VIEW OF ZANUCCOLI	87

I, Bryan J. Ennis, declare as follows:

1. I have been retained as an expert witness on behalf of the Petitioners in this *inter partes* review proceed.

2. I have been asked to render opinions regarding unpatentability of U.S. Patent No. 9,873,638 (“the ‘638 Patent”).

3. I am being compensated at a rate of \$375 per hour for my work in this matter. My compensation is in no way dependent upon the outcome of this proceeding.

EDUCATION AND EXPERIENCE

4. I earned a Bachelor of Science in Chemical Engineering in 1985 from Rensselaer Polytechnic Institute in Troy, NY. In 1990 I received a Master of Science and Doctor of Philosophy in Chemical Engineering from the City College of the City University of New York in New York, NY.

5. My doctoral dissertation, published in 1990, was entitled “On the mechanics of granulation” in which I sought to describe the mechanics of granulation of fine powders. Granulation is a type of agglomeration which was well known at the time, but had not been studied at the microlevel perspective. I received the Stanley Katz Memorial Award for an outstanding doctoral dissertation in chemical engineering the same year.

6. Much of my career has been dedicated to the continuing study of agglomeration on the microlevel. My complete CV is included with this Declaration as Exhibit 1017. I will highlight certain aspects here.

7. Some of my earliest work was in the area of agglomeration for the agricultural industry. In 1992 I published an article in the Chemical Engineering Newsletter entitled "Measuring Granule Size On-Line for Agricultural Products. In 1993 I published an article in the Proceedings of Agglomeration entitled "Drum Granulation of Fertilizers: Modeling & Circuit Simulation." During this time I also led granulation research, solids handling, and powder characterization programs for DuPont Agricultural Products.

8. I have authored and contributed to a number of textbooks on the topic of agglomeration, including authoring Section 21, Solids-Solids Processing & Operations in Perry's Chemical Engineers Handbook 8th Ed (2007) Section 20, Size Enlargement in Perry's Chemical Engineers Handbook 7th Ed (1996). Perry's Chemical Engineers Handbook is one of the preeminent textbooks on chemical engineering. I have also contributed to multiple editions of the Handbook of Pharmaceutical Granulation Technology.

9. I have presented at numerous conferences on the topic of agglomeration. As an example, in 2014, I made two presentations at the American Institute of Chemical Engineers (AIChE) National Meeting entitled "On

Characterizing Particle Shape” and “Learnings & Future Challenges for Granulator Control and Optimization.” I have also organized several Engineering Foundation and AIChE conferences dealing with particle processing and specifically agglomeration processes, namely Control of Particle Processes III, Santa Barbara, 1995, and The First International Particle Technology Forum, Denver, 1994. I received two national awards from AIChE for the latter.

10. My work has otherwise been published dozens of times. For instance in 2001 I co-authored a review in *Powder Technology* entitled “Nucleation, growth & breakage phenomena in wet granulation processes: A review.” That review was cited over 1100 times. The following selection of publications are also particularly relevant to this Declaration:

A microlevel-based characterization of granulation phenomena, *Powder Technology*, 65 (1991) 251-272.

On the Mechanics of Granulation, Ph.D. Thesis, The City College of CUNY, B. Ennis. (Available from the Univ. of Michigan Thesis archive.)

A new approach to modeling granulation processes for simulation & control purposes, *Powder Technology*, 108 (2000) 202–209.

Unifying Approach to Modeling Granule Coalescence Mechanisms, *AIChE Journal*, 43 (1997) 927-934.

Fundamental studies of granule consolidation: Effects of binder content & viscosity, *Powder Technology*, 88 (1996) 15-20.

Population balance modelling of drum granulation of materials with wide size distribution, *Powder Technology*, 82 (1995) 37-49.

Model-based control of a granulation system, *Powder Technology*, 108 (2000) 192–201

Handbook of Pharmaceutical Granulation Tech., 3rd Ed., Chap. 2. Theory of Granulation: An Engineering Perspective, Inform Healthcare, 2009

The Science & Engineering of Granulation Processes, Kluwer Academic, 2004.

Perry's Chemical Engineers Handbook 8th Ed: Sect 21: Solids-Solids Processing & Operations, McGraw-Hill, 2007.

Agglomeration Technology: Equipment Selection, *Chem. Engineering Mag.*, May 2010.

11. I am the founder of E&G Associates, Inc., an engineering consulting and contract research firm specializing in particle processing, powder technology, solids training & continuing education workshops, contract research, and powder characterization. Among many other projects, E&G Associates, Inc. works on the ongoing development of scale-up methodologies for control of wet granulation systems based on formulation properties, as well as other wet and dry agglomeration and size enlargement processes. The framework developed by E&G Associates, Inc. has set new standards for approaching wet granulation problems, and has been employed in the resolution of many manufacturing issues in various industries. This work also includes conducting a set of recognized workshops and training courses attended by hundreds of companies and well over a thousand attendees, including the workshop *Granulation and Compaction for Enhanced Product Performance* taught for over thirty years.

MATERIALS CONSIDERED

12. My analysis as set forth in this declaration is based on my education and experience as described above. I have also relied on the following documents I considered in preparation of this declaration:

Exhibit 1001: '638 Patent

Exhibit 1003: *Agglomeration in Industry*, Pietsch et al.

Exhibit 1004: File History of '638 Patent

Exhibit 1005: US Patent No. 4,954,134 to Harrison

Exhibit 1006: WO 2011/13039 to Anderson

Exhibit 1007: *A Comparison of Liquid Binders for Limestone Pelletizing*, Veverka et al.

Exhibit 1008: JP2004024266 to Shimada

Exhibit 1009: Translation of Shimada

Exhibit 1010: US Patent No. 5,599,373 to Zanuccoli

Exhibit 1011: Excerpt from *Micrometrics, The Technology of Fine Particles*, Second Edition, Dallavalle

Exhibit 1012: *Agglomeration Technology: Mechanisms*, Ennis

Exhibit 1013: *The Influence of Viscosity on the Strength of an Axially Strained Pendular Liquid Bridge*, Ennis et al.

Exhibit 1014: *Fundamental Studies of Granule Consolidation Part 2: Quantifying the Effects of Particle and Binder Properties*, Iveson et al.

Exhibit 1015: *Balling and Granulation*, Kapur

Exhibit 1016: *Effect of Molecular Weight Distribution on Chemical, Structural and Physiochemical Properties of Sodium Lignosulfonates*, Madad et al.

LEGAL PRINCIPLES

13. In opining on the unpatentability of the '638 Patent, I have been asked to apply the following legal principles to my analysis, and I have done so.

A. Person Having Ordinary Skill in the Art ("POSA")

14. I understand that my assessment of the claims of the '638 Patent must be undertaken from the perspective of what would have been known or understood by a person having ordinary skill in the art, reading the '638 Patent on its relevant filing date and in light of the specification and file history of that patent. I often refer to such a person as a "POSA" in this Declaration.

15. I understand that in identifying the appropriate level of one having ordinary skill in the art relevant to a patent, the following four factors may be considered: (a) the types of problems encountered by those working in the field and prior art solutions thereto; (b) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (c) the educational level of active workers in the field; and (d) the educational level of the inventor.

16. At the time of the alleged invention of the '638 Patent, a POSA would have had a bachelor's degree or equivalent in chemical engineering, or at least two years of field experience with agglomeration processes. As described above, I meet these qualifications.

17. My analysis and opinions regarding the claims of the '638 Patent have been based on the perspective of a POSA as defined above as of August 8, 2012, the

filing date of the U.S. provisional patent application to which the '638 Patent claims priority. At that time, I had advanced degrees (beyond a bachelor's) in chemical engineering and many years' experience studying agglomeration processes in the field.

B. The Prior Art

18. I understand that applicable patent law provides categories of information that constitute prior art that may be used to anticipate patent claims or to render them obvious. I understand that for a reference to qualify as prior art to a particular patent claim under the relevant law, that reference must have been made, known, used, published, or patented, or must have been the subject of a patent application by another person, before the priority date of the patent, and in this matter, must satisfy one of the standards of 35 U.S.C. § 102.

C. Claim Construction

19. In making this declaration, I have been asked to review the terms in the '638 Patent claims to determine what a POSA would have understood those terms to have meant at the time of the alleged invention. In addition, I understand that, in an *inter partes* review proceeding, the claim terms under consideration are to be given their ordinary and customary meaning, as would be understood by a POSA at the time of the invention, consistent with the specification and the prosecution history of the '638 Patent.

20. It is my opinion that none of the claim terms of the '638 Patent require any specific constructions for the purposes of this proceeding. In this declaration I give the claim terms their plain and ordinary meaning.

D. Anticipation

21. I understand that to be valid, a patent claim must be “novel,” and that a claim is unpatentable if it is “anticipated” by a single prior art reference. I further understand that a reference anticipates if it discloses each and every element of the claim and enables a POSA to make and use the claimed invention without undue experimentation.

E. Obviousness

22. I understand that even if a claim of a patent is not anticipated, that claim is still unpatentable if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious to a POSA at the time the invention was made.

23. I also understand that an obviousness determination includes several factual inquiries, including: (1) determining the scope and content of the prior art; (2) ascertaining the differences between the claimed invention and the prior art; (3) resolving the level of ordinary skill in the pertinent art; and (4) taking into consideration any secondary indicia (objective evidence) of non-obviousness.

24. I also understand that objective evidence of non-obviousness may include: (1) a long felt but unsolved need that was satisfied by the claimed invention;

(2) commercial success attributable to the claimed invention; (3) unexpected results achieved by the claimed invention; (4) praise by experts of the claimed invention with factual support; (5) taking of licenses under the patent by others for reasons related to the alleged non-obviousness of the claimed invention; (6) the failure of others; (7) the teaching away of others; (8) skepticism by experts; and (9) evidence that competitors in the marketplace have copied the invention instead of using the prior art. I also understand that, in order to establish non-obviousness, there must be a demonstrated relationship, or nexus, between any such secondary indicia and the claimed invention, *i.e.*, there must be objective evidence of non-obviousness attributable to the claimed invention.

25. I understand that a conclusion of obviousness can be based on a combination of multiple prior art references. I understand that there are several rationales that may support a conclusion of obviousness including: (1) combining prior art elements according to known methods to yield predictable results; (2) simply substituting one known element for another to obtain predictable results; (3) using known techniques to improve similar devices (methods, or products) in the same way; (4) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (5) using an “obvious to try” solution, *i.e.*, choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (6) applying known work in one field of

endeavor to yield variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; (7) applying some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference disclosures to arrive at the claimed invention.

26. I also understand that if a technique has been used to improve one device, and if a POSA would recognize the technique would improve similar devices in the same way, then using that technique would be obvious to a POSA.

27. I also understand that when a reference discloses a range that overlaps a claimed range, the claimed range is presumed to be obvious.

28. I also understand that a combination of familiar elements according to known methods is presumed to be obvious when that combination does no more than yield predictable results. If a technique has been used to improve some device, and a POSA can implement a predictable variation of that technique, then that variation is likely unpatentable.

29. I further understand that to be proper for use in an analysis of obviousness, a reference must teach art that is analogous to the claimed invention. I also understand that under a correct analysis, any need or problem known in the field

of endeavor at the time of the invention and addressed by the claimed invention can provide a reason for combining the elements in the manner claimed.

30. I understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in that single reference can be supplied by the common-sense or technical knowledge of the POSA.

31. I also understand that a claimed invention may be obvious if it merely involves simple substitution of one known element for another to obtain predictable results.

32. I also understand that an analysis of obviousness requires a comparison between the properly construed claim language and the prior art on a limitation-by-limitation basis.

TECHNICAL BACKGROUND

33. The '638 Patent relates to a process of agglomerating synthetic gypsum to make fertilizer. Agglomeration is simply the process of sticking together particles of material, and is a form of size enlargement. There are two main types of agglomeration, agitation and compression. This declaration focuses on the former. Agglomeration by agitation includes such equipment such as fluid-beds, rotating drums, pans or discs, and mixers. In this equipment during agglomeration, "granulation" or "pelletization" occurs to form granules or pellets, respectively. For

purposes of this declaration, there is no meaningful difference between pellets and granules and I will refer to them interchangeably. In its most basic form, a dry powder or fine particles are agitated and simultaneously contacted with a binding fluid to cause them to stick together and grow larger particles.

34. Agglomeration processes are typically performed by operators who rely heavily on experience, feel, and observation. Operators adjust the agglomeration conditions to produce pellets or granules with the desired properties. For instance, the operators may add water to the agglomeration equipment if the pellets are not forming as desired, or possess other desired pellet properties.

35. There are a number of factors that influence the formation of the pellets being formed and the properties of those pellets. I explore these factors in my publication “Agglomeration Technology: Mechanisms,” a copy of which is attached as Exhibit 1012. One of the factors is the binder composition, including its character and material properties such as its viscosity, surface tension and contact angle. [Ex. 1012.] In particular, I have extensively studied the effects of binder viscosity during granulation on a microlevel and published my research in 1989, over 20 years before the ‘638 Patent was filed. [See Ex. 1013, Ennis et al., The Influence of Viscosity on the Strength of an Axially Strained Pendular Liquid Bridge, *Chemical Engineering Science*, 45 (1989) 3071-3088.] Others have confirmed as much. [See, e.g., Ex. 1014,

Iveson et al., Fundamental studies of granule consolidation Part 2: Quantifying the effects of particle and binder properties, *Powder Technology*, 99 (1998) 243-250.]

36. The desired properties for the pellets formed by an agglomeration process are usually driven by their end use. [Ex. 1012.] I understand from my review of the prior art (which I will discuss in detail below) and based on my own experience that the properties of fertilizer pellets are often selected for compatibility with modern farming equipment used to distribute the fertilizer in fields. This farming equipment and the specifications for fertilizer pellets that are compatible with it has been known for many years before the ‘638 Patent. For instance in 1978 it was known that the “major objective in fertilizer granulation” was to produce particles in the size range 1-4mm or more narrowly 1.5-3mm. [Ex. 1015, P.C. Kapur, Balling and Granulation, *Advances in Chemical Engineering*, 10 (1978) 55-123 at 106.]

THE ‘638 PATENT

37. The ‘638 Patent relates to a method of turning synthetic gypsum into useful fertilizer pellets by agglomeration. [See, e.g., Ex. 1001 at 1:8-2:11.] The ‘638 Patent teaches feeding synthetic gypsum to a “forming device” such as a pelletizer, granulator, or extruder along with a binder composition. [*Id.* at 2:13-18.] The synthetic gypsum and binder are pelletized to form pellets having a particular size

(expressed as mean pellet size guide number or “SGN”) and crush strength. [*Id.* at 2:18-29.]

A. Main Features of the Claims

38. The claims of the ‘638 Patent are focused on four main features: (1) agglomeration of *synthetic gypsum*, (2) using a *lignosulfonate binder with 18-40% solids*, such that (3) the fertilizer particles have *mean SGN from 100 to 500* and (4) *crush strength from about 2 to about 12 lbf*. I will address each element of each claim of the ‘638 Patent in turn below. In this section, however, I provide some background information for these four main features.

1. Synthetic Gypsum

39. Gypsum is a calcium- and sulfur-based mineral with chemical formula CaSO_4 (calcium sulfate). Gypsum is naturally occurring and when that is the case is referred to as “natural” or “mined” gypsum. Synthetic, or manmade, gypsum is a waste byproduct of certain chemical processes. For instance, synthetic gypsum is a byproduct of processes that scrub sulfur from flue gas emissions in power plants. These processes were developed to reduce sulfur emissions by energy producers in response to concerns about acid rain, which in turn led to legislation limiting the amount of sulfur that could be released into the atmosphere. [Ex. 1003 at 506-509; *see also* 487.] Agglomeration of synthetic gypsum has been known for many years as a way to convert the byproduct into a useful product, fertilizer.

2. Lignosulfonate Binder

40. Lignosulfonate is a byproduct of the production of wood pulp in the paper industry. [See, e.g., Ex. 1016, Madad et al, *Rasayan J. Chem.*, Vol. 4, No. 1 (2011) 189-202.] It is a water-soluble polymer that has many industrial applications. [Id.] In agglomeration processes, it is a ubiquitous binder and has been for decades. In most cases, when used as a binder lignosulfonate is diluted in water. Lignosulfonate-water solutions have lignosulfonate solids dispersed throughout the solution. The amount of lignosulfonate in the solution affects the viscosity of the solution (more lignosulfonate means higher viscosity). [Id.]

41. The amount of lignosulfonate in the solution is normally expressed as a percentage. [See, e.g., *Id* at Table 1.] Most commonly, the percentage is on a weight-basis, i.e., the percent is the weight of lignosulfonate in the solution divided by the total weight of the solution. When a percentage of lignosulfonates is expressed without specifying that it is on a weight basis I assume that to be the case because that is how the composition of a lignosulfonate solution is normally expressed.

42. The '638 Patent claims a range of 18 to 40% solids for its lignosulfonate binder composition. I take this to mean that the lignosulfonate binder composition was made by mixing lignosulfonate solids with water such that 18 to 40% of the weight of the mixture is the lignosulfonate. Therefore I take "18 to 40% solids" as

used in the '638 Patent to mean that 18 to 40% of the binder composition by weight is lignosulfonate.

3. Particle Size

43. There are a number of ways that particle size is expressed in the agglomeration and other industries. In the case of agitative agglomeration, pellets are approximately spherical and the size of a particle is its diameter. One way to express particle is by size guide number (SGN) which is a median or 50% diameter particle size multiplied by 100 for a set of particles. Said another way, half of the particles in the set are smaller than the median size and half are larger than this median size. The median size is often referred to as the 50% diameter as well. SGN is calculated by multiplying the median particle size in millimeters (mm) by 100. So, an SGN of 100 corresponds to median or 50% diameter particle size of 1 mm. This is consistent with the way the '638 Patent uses the term SGN. [Ex. 1001 at 5:62-67.]

44. For a given set of particles having a range of sizes between a minimum and a maximum, the SGN is necessarily between the minimum and maximum for which a substantial portion of the distribution lies between this minimum and maximum, namely, at least 50%. For instance, for a given set of particles between 1 and 5 mm in size, the median particle size is necessarily between 1 and 5 mm, and therefore the SGN of the set is between 100 and 500.

45. The '638 Patent claims a "mean pellet size guide number" of between approximately 100 to approximately 500. Since pellet size guide number is already a "median size" in most cases is close to the volume mean pellet size, the word "mean" preceding "pellet size guide number" is redundant and misapplied. However, the claimed range of approximately 100 to approximately 500 corresponds to median particle size between approximately 1 mm and approximately 5 mm, which is what I would expect for fertilizer products based on the prior art I have reviewed, discussed below, and my own experience. [See also Ex. 1016 at 106.] Therefore, I take "mean pellet size guide number" as used in the '638 Patent to be simply SGN, which is 100 times the median or 50% diameter.

46. Another common way to express particle size is by mesh size. Particles are sized using meshes with uniform openings of known size. Particles smaller than the openings pass through the mesh while particles larger than the openings are retained on the mesh. There are two common standardized sets of meshes, Tyler mesh and U.S. Standard Sieve Size, which are largely similar but have some slight differences. Exhibit 1011 shows the opening size for Tyler meshes and U.S. Standard Sieve Size meshes.

47. The meshes are denoted as ## mesh, for a Tyler mesh or No. ## mesh for the U.S. Standard Sieve Size.

48. For Tyler mesh, the number corresponds to how many openings there are per linear inch in the mesh. So, a 200 mesh would have 200 openings in one linear inch and each opening is 0.0029 inches across (0.074 mm). The 200 mesh would allow particles less than 0.074 mm in diameter to pass through while retaining particles larger than 0.074 mm. For both systems, the higher the number the smaller the openings in the mesh.

49. The terminology “minus x plus y” refers to particles that pass through the x mesh but are retained on the y mesh, meaning the particles have a size larger than the openings in the y mesh but smaller than the openings in the x mesh.

4. Crush Strength

50. Crush strength in the agglomeration industry measures how much force is required to break apart a pellet and corresponds to how strong the pellet is. Force can be expressed using a force unit, such as Newtons, or in terms of units typically associated with weight such as pounds (lb) of force or kilograms (kg) of force. The ‘638 patent claims particles with crush strength between approximately 2 lbf and approximately 12 lbf. “Lbf” is an abbreviation for “pounds of force.” Another way to express this claimed crush strength would be 2 lb to 12 lb. The industry practice is that “pounds” or its abbreviation “lb” is understood as pounds of force rather than pounds of mass (abbreviated as “lb-m”), which is a weight measurement not applicable for crush strength.

B. Prosecution History

51. I have reviewed the prosecution history for the '638 Patent. The application that lead to the '638 Patent started out by claiming feeding synthetic gypsum to a forming device, feeding a binder composition to the forming device, and forming the material fed to the forming device to a particular mean pellet SGN. [Exhibit 1004, File History for '638 Patent at 384.] The independent claims were amended several times during prosecution to specify crush strength, solids content of the binder composition, identity of the binder composition [*Id.* at 296-299, 236-240, 200-204.] The claims were eventually allowed after the Examiner considered a declaration of one of the inventors and determined that the prior art relied on in the pending rejections did not teach the claimed crush strength. [*Id.* at 102-109.]

52. Prosecution was then reopened. [*Id.* at 76-77.] The independent claims were amended to narrow the range of solids content of the lignosulfonate binder composition from 18-48% solids to 18-40% solids. [*Id.* at 27-31.] The Examiner then allowed the application. [*Id.* at 24-25, 9-10.]

SCOPE AND CONTENT OF THE PRIOR ART

A. Harrison (Exhibit 1005)

53. U.S. Patent No. 4,954,134 to Harrison et al. ("Harrison") was issued to the Tennessee Valley Authority, an energy producer that developed a way to turn manmade gypsum into fertilizer pellets. Harrison was filed in 1989. Harrison teaches

that gypsum is a calcium- and sulfur-rich mineral commonly used for the cropping of peanuts and in other agricultural applications. [Ex. 1005 at 2:12-35.] Prior to Harrison, agricultural gypsum was available in the form of very fine (small) particles or powders. [*Id.* at 2:36-44.] The small particle size allowed for ready release of the calcium and sulfur constituents into the soil. [*Id.*] However, modern fertilizer-application equipment was designed to distribute larger free-flowing fertilizer granules, and did not work well for agricultural gypsum. [*Id.* at 2:44-52.]

54. Harrison sought to make gypsum fertilizer pellets large enough to be distributed by modern fertilizer-application equipment, but at the same time that would readily break down and supply calcium and sulfur to the soil. [*Id.* at 3:62-4:4.] Harrison did so by employing a previously known binder, lignosulfonate, in a particular quantity to agglomerate gypsum into fertilizer pellets. [*Id.* at 2:60-3:46, 4:10-40.] Specifically, Harrison uses a binder composition that has “about 25 percent by weight lignosulfonate and the remainder is water.” [*Id.* at 8:36-44.] Harrison teaches that using this binder composition to agglomerate gypsum produces fertilizer pellets that have crushing strengths from about 4 to about 8 pounds and that have size range “minus 7 plus 8 Tyler mesh” which corresponds to particles sizes ranging from 2.38 mm - 2.83 mm. [Ex. 1011.]

B. Anderson (Exhibit 1006)

55. International Patent Publication No. WO 2011/113039 to Anderson et. al (“Anderson”) claims priority to a U.S. Provisional Patent Application filed in 2010 and was published in 2011. Like Harrison, Anderson teaches a way to make waste products into useful particles or pellets for agricultural applications. [See generally Ex. 1006 at ¶¶[0002]-[0010].] Anderson teaches making granules containing gypsum using a lignosulfonate binder. [Id. at ¶¶[0018], [0026], [0057]-[0059].] The binder is a water-based solution having between 40-50% solids by weight, but up to 15% by weight additional water can be added as necessary to achieve agglomeration. [Id. at ¶¶[0027], [0046].] Anderson also teaches that the granule can contain mineral or synthetic elements. [Id. at ¶[0017].] Anderson’s pellets have a crush strength between 2 and 8 pounds (which is understood to refer to pounds of force, or lbf) and size guide number between 100 and 230. [Id. at ¶¶[0052], [0054].]

C. Pietsch (Exhibit 1003)

56. Agglomeration in Industry: Occurrence and Applications by Wolfgang Pietsch (“Pietsch”) is a textbook about the occurrence and key applications of agglomeration across multiple industries. Pietsch was published in 2005. Section 8.2.2 addresses Agglomeration Technologies for the Size Enlargement of Wastes. In particular, Pietsch teaches using waste product to make fertilizers as well as agglomeration of synthetic gypsum that is a byproduct of FGD processes. [Ex. 1003 at 505-509; see also 487.]

D. Veverka (Ex. 1007)

57. Veverka is a 2001 publication of the Institute for Briquetting and Agglomeration. Veverka describes a test conducted to determine the best binding agent for pelletizing limestone into fertilizer pellets and is intended to inform the design of larger-scale fertilizer producing operations. [Ex. 1007 at § 2.] Veverka teaches that the fertilizer pellets should have a crush strength of 4.0 # (which is a symbol for pounds). [*Id.* at § 6.1.4.] Veverka also teaches the fertilizer pellets should be sized to be “passing through 4 mesh but be retained on 20 mesh” which corresponds particles sizes ranging from 0.841 mm – 4.76 mm. [*Id.* at § 4.1; Ex. 1011]

58. Veverka tests several binders including lignosulfonate binders in an agglomeration process conducted in a pin mixer, which is a type of forming device. [*Id.* at §§ 4.1, 7.1, Binder #1 (Norlig 12) and Binder #2 (Norlig A).] Before being fed to the pin mixer, the binders were diluted as shown in Veverka’s Table 4.4.1. After dilution, Binder #1 had 19.76% solids and Binder #2 had 20.09% solids.

E. Shimada (Ex. 1008)

59. Japanese Patent Publication No. JP2004-024266 to Shimada et al. (“Shimada”) was published in 2004. A translation of Shimada is attached as Exhibit 1009 and I will refer to that translation in this Declaration. Shimada relates to a gypsum fertilizer and method of making the gypsum fertilizer. Much like Harrison, Shimada aims to provide fertilizer pellets that are large enough and hard enough to

be dispersed using mechanical means but that still exhibit good disintegration properties in soil. [Ex. 1009 at ¶¶[0004]-[0007].] To that end, Shimada teaches that its fertilizer pellets have an average hardness of 1 kg (2.2 lbs) or more and average particle size from 1 to 4 mm. [*Id.* at ¶¶[0019]-[0020], [0030].]

60. To make its fertilizer pellets, Shimada teaches using a drum-type granulator to granulate synthetic gypsum such as by-product gypsum. [*Id.* at ¶¶[0014], [0019], [0049].] As a “granulation aid” for its process Shimada teaches using a composition with lignosulfonate. [*Id.* at ¶¶[0011], [0049].] A granulation aid is another word for a binder.

F. Zanuccoli (Ex. 1010)

61. U.S. Patent No. 5,599,373 to Zanuccoli (“Zanuccoli”) was filed in 1994. Zanuccoli relates to a sulfur-based fertilizer, and more specifically, pellets containing fly sulfur powder and a wetting agent (or binder) which is preferably lignin sulfonate. [Ex. 1010 at 1:20-30, 2:18-38.] Fly sulfur powder is elemental sulfur. The pellets can also comprise gypsum. [*Id.* at 3:39-41.] Zanuccoli further teaches that in a fertilizer, sulfur provides the benefit of correcting alkalinity of soil and intervening with sodium-calcium ionic exchange. [*Id.* at 1:31-45.] Zanuccoli aims to create a granular sulfur fertilizer that is easy to handle and can rapidly disintegrate in soil water. [*Id.* at 2:38-43.]

ANALYSIS OF UNPATENTABILITY OF THE '638 PATENT

A. Summary of Opinions

62. Based on my review of the prior art discussed in this declaration as well as my education and experience, it is my opinion that all claims of the '638 Patent are unpatentable. The chart below summarizes the prior art and bases on which my opinion is made for each claim of the '638 Patent.

Ground	Prior Art	Claims Challenged
1	Anticipated under 35 U.S.C. § 102 by Harrison	1-3, 5, 9-12, 14
2	Obvious over 35 U.S.C. § 103 over Harrison	1-3, 5, 7, 9-12, 14, 16
3	Obvious under 35 U.S.C. § 103 over Anderson in view of Pietsch	1-3, 8, 9, 10-12
4	Obvious under 35 U.S.C. § 103 over Veverka in view of Harrison or in view of Peitsch as evidenced by Harrison	1-3, 5, 7, 8, 10-12, 14, 16-19, 22, 23
5	Obvious under 35 U.S.C. § 103 over Shimada in view of Harrison	1-5, 7, 9-14, 16
6	Obvious under 35 U.S.C. § 103 over Harrison, Anderson in view of Pietsch, Veverka in view of Harrison or Pietsch as evidenced by Harrison, or Shimada in view of Harrison, and in further view of Zanuccoli	5, 6, 14, 15, 20, 21

GROUND 1 – ANTICIPATION BY HARRISON

63. It is my opinion that Harrison anticipates claims 1-3, 5, 9-12, 14 of the '638 Patent.

A. Claim 1

64. I will address the preamble and elements of claim 1 as identified below:

[Preamble] 1. A method of producing a fertilizer comprising:

[1a] feeding synthetic gypsum to a forming device

[1b] feeding a binder composition comprising lignosulfonate having 18% to 40% solids to the forming device; and

[1c] forming the material fed to the forming device to a mean pellet size guide number (SGN) from approximately 100 to approximately 500, **[1d]** wherein the resulting pelletized synthetic gypsum has a crush strength from approximately 2 lbf to approximately 12 lbf.

1. Preamble

65. Harrison teaches a method of producing a fertilizer. [See, e.g., Ex. 1005 at 5:23-30.]

2. Element 1a

66. Harrison teaches feeding synthetic gypsum to a forming device. Figure 2 from Harrison is annotated below to highlight gypsum (red) fed to a granulator (blue). [See also, e.g., Ex. 1005 at 10:40-52.] A granulator is a type of forming device in the agglomeration industry. A granulator “forms” granules. The ‘638 Patent also recognizes as much. [Ex. 1001 at 2:14-16 (“...a forming device, which may comprise a pelletizer, granulator, or extruder”), claim 9 (“wherein the forming device comprises a granulator”).]

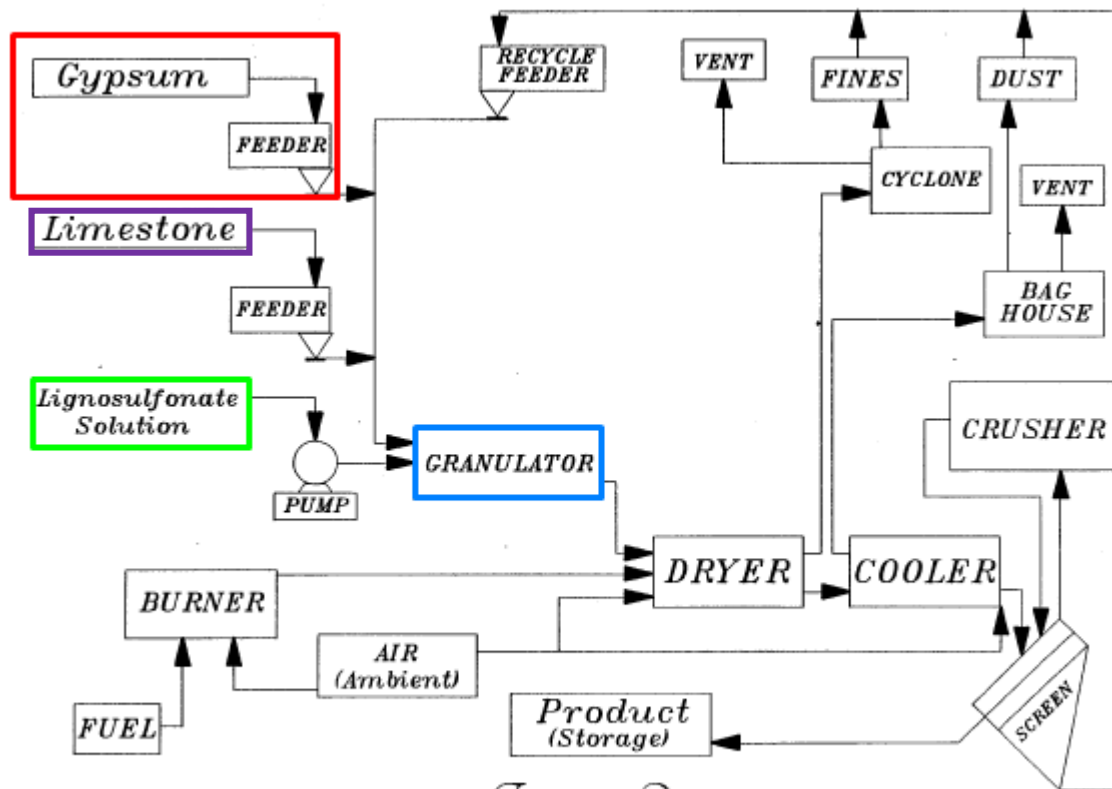


Fig. 2

67. Harrison teaches that its Figure 2 illustrates a process for granulating “finely-divided gypsum” in a full-scale production facility and Harrison defines the term “finely-divided gypsum” as including mined (natural) gypsum and manmade (synthetic) by-product gypsum. [Ex. 1005 at 2:21-23; *see also* 6:62-7:2, 7:13-24; 9:16-48.]

3. Element 1b

68. Harrison teaches feeding a binder composition comprising lignosulfonate having 18% to 40% solids to the forming device. Harrison uses a binder composition comprising lignosulfonate. [Ex. 1005 at 10:53-55.] Specifically,

Harrison has two options for lignosulfonate binder solutions. Each is obtained from a material supplier and then diluted with water to have about 24% lignosulfonate for the first option or about 29% lignosulfonate for the second option. [Ex. 1005 at 8:36-44 , 10:55-11:12.] Elsewhere Harrison explains that its binder composition is about 25% by weight lignosulfonate. [*Id.*]

69. As I explained above, expressing a lignosulfonate content of a binder composition in terms of simply a percentage or a percentage by weight as in Harrison is equivalent and directly comparable to the ‘638 Patent’s expression of a binder composition having a certain “% solids.” Harrison also uses the term “percent additive/dispersant” which is equivalent to the term “% solids.” [Ex. 1005 at 11:10-12.] Thus when Harrison refers to its lignosulfonate solution having 25% by weight lignosulfonate, I take that to be equivalent to a lignosulfonate binder composition that is 25% solids using the language of the ‘638 Patent. Harrison’s binder composition is within the claimed range of 18 to 40% solids in the ‘638 Patent.

70. As shown in annotated Figure 2 above, Harrison feeds the lignosulfonate solution (green) to its forming device (granulator, blue). [*See also* Ex. 1005 at 11:23-41 (describing spraying or sparging the lignosulfonate into the granulator).]

4. *Element 1c*

71. Harrison teaches forming the mixture to a mean pellet size guide number (SGN) from approximately 100 to approximately 500. Harrison does not use the term SGN and instead refers to particle size in terms of Tyler Standard Screen Scale mesh size, which I described in detail above. Harrison teaches that the desired particle size for fertilizers is minus 6 plus 16 Tyler mesh, which corresponds to particles with diameters between 1 mm and 3.36 mm or SGN of 100 to 336. [Ex. 1005 at 11:65-12:36.]

72. Harrison further teaches that when running its process, the onsize particles (those within the desired size range) produced by its method are retained on the 16 Tyler mesh (have particle size greater than 1 mm) and pass through the 6 mesh (have particle size less than 3.36 mm). [*Id.*] In addition, offsize (too large or too small) particles are recycled back through the process. [*Id.*] On the next go-around though the granulation steps, these particles will meet the desired size or be recycled again. This indicates to me that Harrison aims for its particle to be within the desired range and continues its process to achieve that goal. In particular, Harrison teaches that the desired “onsized fraction utilized in the fertilizer industry” is 98% minus 6 mesh plus 16 mesh. [*Id.*] The median or 50% diameter particle size of Harrison’s particles is necessarily within the range of minus 6 mesh plus 16 mesh

or 1 mm and 3.36 mm, as discussed above, and thus the SGN is between 100 and 336, within the claimed range.

73. Harrison further teaches that the product of its process has a desired size distribution that is 36% plus 8 mesh or 2.38 mm, and 69% plus 9 mesh or 2 mm. [*Id.*] The median or 50% diameter particle size of Harrison's particles is necessarily within the range of minus 8 mesh plus 9 mesh, or 2 mm and 2.38 mm, as discussed above, and thus the SGN is between 200 and 238, within the claimed range.

5. *Element 1d*

74. Harrison's resulting product is a pelletized synthetic gypsum with a crush strength within the claimed range of approximately 2 lbf to approximately 12 lbf. that the portion of its product in the size range plus 7 minus 8 Tyler mesh exhibits crushing strengths of "from about 4 to about 8 pounds." [Ex. 1005 at 8:36-64.] Harrison also notes this is the industry standard way of characterizing crush strength of a set of particles, which I agree with based on my own experience. [*Id.*] As I explained in detail above, I take the term "pounds" as used by Harrison to mean "pounds of force" because Harrison is referring to a crush strength, which as accepted by the industry is a force. This falls within the approximately 2 lbf to approximately 12 lbf range in claim 1 of the '638 Patent.

B. Claim 11

75. Claim 11 recites a preamble and four elements which I have identified as follows:

[Preamble] 11. A fertilizer comprising:

[11a] pellets, the pellets comprising synthetic gypsum

[11b] and a binder composition comprising lignosulfonate, wherein the binder composition initially has 18% to 40% solids at the time of contact with the synthetic gypsum,

[11c] the pellets further comprising mean pellet SGN from approximately 100 to approximately 500,

[11d] wherein the pellets have a crush strength from approximately 2 to approximately 12 lbf.

1. Preamble

76. Harrison teaches a fertilizer. [Ex. 1005 at 5:23-30 (emphasis added).]

2. Element 11a

77. As noted above for the preamble, and for similar Element 1a, Harrison teaches making granules, or pellets, from finely-divided gypsum, which includes synthetic gypsum.

3. Element 11b

78. As discussed above for similar Element 1b, Harrison teaches preparing a lignosulfonate binder solution having 25% solids. Harrison further teaches that the binder solution having 25% solids lignosulfonate is prepared and then introduced into the granulation equipment with the synthetic gypsum feedstock. Thus at the time

of contact with the synthetic gypsum, the lignosulfonate binder composition has 25% solids, which falls within the claimed range of 18% to 40% solids.

4. Element 11c

79. As discussed above for similar Element 1c, Harrison teaches that accepted particle size in the fertilizer industry is median particle or 50 percent diameter particle between 1 and 3.36 mm or SGN between 100 and 336. Harrison also teaches the particles resulting from its process have median particle or 50 percent diameter between 2 and 2.38 mm or SGN between 200 and 238, all falling within the claimed range.

5. Element 11d

80. As discussed above for similar Element 1d, Harrison's pellets have crushing strengths of from about 4 to about 8 pounds, which I take to mean pounds of force. [Ex. 1005 at 8:36-44.] This falls within the claimed range.

C. Claim 2

81. Claim 2 depends from claim 1 and further recites "wherein the synthetic gypsum fed to the forming device has a mean particle size of less than 100 microns." However, the '638 Patent does not say what average or underlying basis is used to determine the mean (such as particle weight, particle volume, or number of particles). There are two common "means" in the agglomeration industry, volume mean particle size and Sauter mean size, both using particle weight as a basis. The volume mean size is typically calculated by multiplying the percentage of product

weight between two mesh sizes by the average of the mesh sizes in microns, and taking the sum of these values. The Sauter mean size is taken by dividing the weight between mesh sizes the by the average mesh particle size, summing these values, and then taking the reciprocal to produce the mean size.

82. Harrison teaches in one example using granular gypsum with a particular particle size distribution. [Ex. 1005 at 7:12-26.] I have performed calculations of the volume-mean and Sauter-mean (also called surface-volume mean) diameters as described above using Harrison's disclosed particle size distribution. My analysis is based on the following particle size distribution which falls within the ranges taught by Harrison. Based on Harrison's disclosure, and my own experience, it would have been obvious to select this example set of particles falling within the size ranges taught by Harrison.

0.1% of the particles are 1.13 mm

1.0% of the particles are 0.63 mm

10.0% of the particles are 0.28 mm

38.9% of the particles are 0.097 mm

50.0% of the particles are 0.032 mm

83. The volume mean diameter of this set of particles is 0.089 mm or 89 microns, which is less than 100 microns as in claim 2. The Sauter mean diameter of

this set of particles is 0.050 mm or 50 microns, which is also less than 100 microns as in claim 2.

D. Claims 3 and 12

84. Claim 3 depends from claim 1 and further recites “wherein the binder composition comprises a water soluble binder.” Claim 12 depends from claim 11 and recites the same. As discussed above for Elements 1b and 11b, Harrison uses a binder composition comprising lignosulfonate. Lignosulfonate is a water soluble binder, as I noted above.

E. Claims 5 and 14

85. Claim 5 depends from claim 1 and recites “further comprising feeding an additive to the forming device, wherein the additive is selected from the group consisting of ground calcium carbonate, calcium bentonite, kaolin clays, manganese, zinc, boron, calcium, copper, and elemental sulfur.” Claim 14 depends from claim 11 and recites that the pellets further comprise the same. Harrison discloses granulating gypsum together with limestone, which is calcium carbonate. [Ex. 1005 at 5:23-30 (emphasis added); *see also* 2:1-2 (limestone is calcium carbonate), 10:7-52 (describing granulating mixtures of gypsum and limestone).] Likewise annotated Figure 2, above, shows limestone (purple) being fed to the granulator along with the gypsum and lignosulfonate binder.

F. Claim 9

86. Claim 9 depends from claim 1 and recites “wherein the forming device comprises a granulator or extruder.” As discussed above for Element 1a, Harrison teaches that its forming device is a granulator.

G. Claim 10

87. Claim 10 depends from claim 1 and recites “[a] fertilizer made by the process of claim 1.” As discussed above for the preamble of claim 1, Harrison discloses a fertilizer made by its method.

GROUND 2 – OBVIOUSNESS OVER HARRISON

88. As discussed above for Ground 1, it is my opinion that Harrison anticipates claims 1-3, 5, 9-12 and 16 of the '638 Patent. Alternatively or additionally, it is my opinion that Harrison's Example II renders obvious claims 1-3, 5, 7, 9-12, 14, and 16 of the '638 Patent. In this section I refer to the same preamble and claim elements as for Ground 1.

A. Claim 1

1. Preamble

89. While Harrison's Example II does not specify that it is a method of producing a fertilizer, Harrison teaches as the object of its invention a method of producing a fertilizer. [Ex. 1005 at 5:23-30 (emphasis added).] Moreover, Harrison teaches that its examples illustrate how to practice its invention. [*Id.* at 12:39-42.]

Accordingly, based on the teachings of Harrison and my own experience, I understand the product of Example II to be a fertilizer.

2. Element 1a

90. Harrison teaches feeding synthetic gypsum to a forming device. Specifically, in Example II, Harrison provides a mixture comprising 90% gypsum and 10% limestone to a drum granulator. [Ex. 1003 at 17:19-29 (referring to 13:11-25; Figure 1).] As I discussed above for Element 1a of Ground I, a granulator and more specifically a drum granulator is a type of forming device. In Table 1, which reports the result of Example II, Harrison indicates the gypsum used can be sulfogypsum, a type of synthetic gypsum. [Ex. 1005 at 17:53-55, Table 1 at n. e; *see also* 12:51-52, 2:12-16.]

3. Element 1b

91. Harrison renders obvious feeding a binder composition comprising lignosulfonate having 18% to 40% solids to the forming device. Specifically, Harrison teaches using a 48% lignosulfonate solution in Example II. [Ex. 1005 at 17:29-34.] As I discussed above for Element 1b in Ground 1, I take this to mean a 48% solids lignosulfonate solution. The solution is diluted with additional water at ratios between 1:1 and 1:3, which corresponds to solutions having between 12 and 24% solids, before being sprayed onto the synthetic gypsum material in the drum granulator. [Ex. 1005 at 17:29-34.] This range overlaps the claimed range of 18% to

40% solids. Given the overlap, I would have found it obvious to select within the claimed range of % solids.

4. Element 1c

92. After feeding synthetic gypsum and lignosulfonate binder into the granulator, Harrison teaches forming the mixture to a mean pellet size guide number (SGN) from approximately 100 to approximately 500. In Example II, Harrison produced 9 test batches. Table I summarizes the ex-dryer and product pellet size distributions and crush strengths of these tests. 99.7% of the product particles were between the sizes of minus 5 mesh plus 16 mesh Tyler Standard Screen Scale, which corresponds to particles with diameters between 1 mm and 4 mm. The median or 50% diameter is contained within this size cut, and therefore the median diameter falls between 1 and 4 mm and the SGN between 100 and 400. [Ex. 1005, Table 1; Ex. 1011.] This falls within the claimed range.

93. Furthermore, 51.1% of the product particles were between the sizes of minus 6 mesh plus 8 mesh Tyler Standard Screen Scale, which corresponds to particles with diameters between 2.38 mm and 3.36 mm. The median or 50% diameter is contained within the size cut, and therefore the median diameter falls between 2.38 mm and 3.36 mm and the SGN between 238 and 336. [Ex. 1005, Table 1; Ex. 1011.] This falls within the claimed range.

94. Furthermore, Table I demonstrates that 68.2% of the ex-dryer particles were between the sizes of minus 6 mesh plus 16 mesh Tyler Standard Screen Scale, which corresponds to particles with diameters between 1 mm and 3.36 mm. The median or 50% diameter is contained within this size cut, and therefore the median diameter falls between 1 and 3.36 mm and the SGN between 100 and 336. [Ex. 1005, Table 1; Ex. 1011.] This falls within the claimed range.

95. Furthermore, for the nine batches produced in Example II, material discharged from the granulator sized minus 6 plus 16 mesh Tyler Standard Screen Scale ranged from 42 to 76 percent, which corresponds to particles with diameters between 1 mm and 3.36 mm. In the latter case of 76%, the median or 50% diameter must be contained within the range of 1 mm to 3.36 mm, and therefore this case has an SGN of 100 to 336, also within the claimed range.

96. In the former case, since 42% of the distribution lies between minus 6 mesh and plus 16 mesh, then 58% of the distribution is split between plus 6 mesh or 3.36 mm, and minus 16 mesh or 1 mm. [Ex. 1005 at 17:38-40, Table 1; Ex. 1011.] Table 1 demonstrates that for ex-dryer samples, 25.1% of the particle are plus 6 mesh or 3.36 mm, and 6.7% of the particles are minus 16 mesh or 1 mm. Therefore as an example, approximately 25% of the granulator pellet material will be plus 6 mesh and 68 % will be plus 16 mesh. Therefore in this former case, the 42% of material also likely contains the median or 50% diameter within the range of some value

greater than 1 mm and the value of 3.36 mm, and therefore this case has an SGN between 100 and 336, also within the claimed range.

97. Harrison further teaches that some portion of the product which was used to test crush strength previously described falls within the Tyler Standard Screen Scale size range of minus 7 plus 8 mesh, which corresponds to particle sizes ranging from 2.38 to 2.83 mm and has SGN between 238 and 283. [Ex. 1005 at 17:38-49, Table 1; Ex. 1011.] This range is also within the claimed range.

5. Element 1d

98. Harrison renders obvious a pelletized synthetic gypsum with a crush strength of approximately 2 lbf to approximately 12 lbf. Harrison teaches that immediately after being discharged from the granulator, the particles falling in the minus 7 plus 8 mesh size range (or between 2.38 and 2.83 mm, within the 1 to 5 mm or SGN of 100 to 500 range) have a crushing strength ranging between about 1 to about 2 pounds, which I take to mean “pounds of force” for the reasons I explained above. [Ex. 1005 at 13:78-45.] Harrison also notes this is the industry standard way of characterizing crush strength of a set of particles, which I agree with. [Ex. 1005 at 8:36-64.] Harrison’s 1 to 2 lbf range overlaps the claimed approximately 2 lbf to approximately 12 lbf range. Given the overlap, I would have found it obvious to select within the claimed range.

99. Moreover, after drying and screening the particle products from Example II, the particles falling in the minus 7 plus 8 mesh size range have a crushing strength of about 4 pounds or “pounds of force.” [Ex. 1005 at 17:45-49.] This falls within the claimed range.

B. Claim 11

1. Preamble

100. As discussed above for the preamble of claim 1, a POSA would understand the product of Harrison’s Example II to be a fertilizer.

2. Element 11a

101. As noted above for the preamble, and for similar Element 1a discussed above, Harrison teaches granulating sulfogypsum, a type of synthetic gypsum, in Example II.

3. Element 11b

102. As discussed above for similar Element 1b, Harrison’s Example II uses a 48% lignosulfonate solution in Example II diluted to a solution having between 12 and 24% lignosulfonate, before being sprayed onto the synthetic gypsum material in the drum granulator. I take this to mean a lignosulfonate binder composition having 12 to 24% solids. Given the overlap, I would have found it obvious to select within the claimed range of % solids.

4. Element 11c

103. As discussed above for Element 1c, in Harrison's Example II, product has SGN between 100 and 500 immediately after granulation, after drying, and after screening.

5. Element 11d

104. As discussed above for Element 1d, Harrison teaches that immediately after being discharged from the granulator, the particles have crush strengths between 1 and 2 lbf, which overlaps the approximately 2 lbf to approximately 12 lbf claimed range. Given the overlap, I would have found it obvious to select within the claimed range of crush strength.

105. Moreover, after drying and screening the particle products from Example II, the particles falling in the minus 7 plus 8 mesh size range have a crushing strength of about 4 lbf, which falls within the approximately 2 lbf to approximately 12 lbf range.

C. Claim 2

106. Harrison's Example II teaches synthetic gypsum fed to the forming device that has a mean particle size of less than 100 microns. The starting product consists of 90% gypsum with size distribution 35 to 50% plus 200 mesh (greater than 74 microns), 6 to 14 % plus 325 mesh (greater than 44 microns), and about 40 to 80 % minus 325 mesh (less than 44 microns) on the US Standard Screen Scale and 10% limestone with at least 90% passing through No. 10 mesh (smaller than 2

mm or 2000 microns) and at least 50% passing through No. 60 mesh (smaller than 250 microns) US Standard Testing Sieves, which have US Standard Screen Scale meshes. [Ex. 1005 at (17:19-26 (referring to 13:11-14); Ex. 1011.] Similar to my analysis for claim 2 in Ground 1 above, a set of gypsum particles falling within these size ranges is 70% at 26 microns, 10% at 53 microns, 10% at 110 microns, 7% at 280 microns, and 3% at 630 microns, which has a volume-mean average diameter of 73 microns and a Sauter-mean average diameter of 33 microns.

107. Similar to my analysis for claim 2 in Ground 1 above, a set of limestone particles falling within these size ranges is 21% at 26 microns, 21% at 53 microns, 20% at 110 microns, 25% at 200 microns, 7% at 330 microns, 5% at 630 microns, and 1% at 1400 microns, which has a volume-mean average diameter of 157 microns whereas the Sauter-mean average diameter is 65 microns.

108. The combined feed of gypsum and limestone from this sample calculation from Harrison in the ratio of 90% gypsum to 10% limestone would have particles falling within the size ranges of 65.1% at 26 microns, 11.1% at 53 microns, 11% at 110 microns, 9.5% at 280 microns, 3.2% at 630 microns, and 0.1% at 1120 microns, which has a volume-mean average diameter of 83 microns and a Sauter-mean average diameter of 35 microns. The average particle size of the mixture of gypsum and limestone particles is less than 100 microns. Based on Harrison's

disclosure, and my own experience, it would have been obvious to select this example set of particles falling within the size ranges taught by Harrison.

D. Claims 3 and 12

109. Harrison discloses a binder composition that comprises a water soluble binder. As discussed above for Elements 1b and 11b, Harrison uses a binder composition comprising lignosulfonate in Example II. Lignosulfonate is a water soluble binder.

E. Claims 5 and 14

110. Harrison discloses feeding an additive to the forming device, wherein the additive is selected from the group consisting of ground calcium carbonate, calcium bentonite, kaolin clays, manganese, zinc, boron, calcium, copper, and elemental sulfur and pellets comprising the same, as I discussed above for claims 5 and 14 in Ground 1.

F. Claims 7 and 16

111. Harrison discloses particles with mean SGN is from approximately 250 to approximately 280. As discussed above for Elements 1c and 11c, Harrison teaches that some portion of the product in Example II used to test crush strength falls within the Tyler Standard Screen Scale size range of minus 7 plus 8 mesh, which corresponds to particle sizes ranging from 2.38 to 2.83 mm and SGN between 238 and 283. I would consider this to be equivalent to the claimed range of approximately 250 to approximately 280 in claims 7 and 16.

G. Claim 9

112. Harrison discloses that the forming device comprises a granulator or extruder. As shown above for Element 1a, Harrison uses a drum granulator in Example II.

H. Claim 10

113. Harrison discloses a fertilizer made by its process, as shown above for the preambles of claims 1 and 11.

GROUND 3 – OBVIOUSNESS OVER ANDERSON IN VIEW OF PIETSCH

114. It is my opinion that claims 1-3, 8, 9, 10-12 of the '638 Patent are obvious over Anderson in view of Pietsch. I will refer to the same claim elements as discussed above in Grounds 1 and 2.

A. Claim 1

1. Preamble

115. Anderson teaches a method of producing a fertilizer. [Ex. 1006 at ¶[0014].]

2. Element 1a

116. Anderson teaches feeding synthetic gypsum to a forming device. Specifically, Anderson teaches feeding an admixture to pelletizing equipment such as a pelletizing pan, or granulation equipment such as a drum granulator. [Ex. 1006 at ¶[0047].] Pelletizers and granulators are types of forming devices since they “form” pellets or granules, respectively. This is also recognized in the specification

of the '638 Patent. [Ex. 1001 at 2:14-16 (“...a forming device, which may comprise a pelletizer, granulator, or extruder”), claim 8 (“wherein the forming device comprises a pelletizer”), claim 9 (“wherein the forming device comprises a granulator”).] Anderson further teaches that the admixture may include any of the previously-described components, such as gypsum. [Ex. 1006 at ¶¶[0018], [0046]; *see also* ¶[0059] (describing example process for forming granules with gypsum).] In addition, Anderson teaches that the granules can comprise synthetic chemical fragments, of which synthetic gypsum would be an example. [Ex. 1006 at ¶[0017].]

117. Pietsch teaches using waste product to make fertilizers as well as agglomeration of synthetic gypsum that is a byproduct of FGD processes. [Ex. 1003 at 505-509; *see also* 487.] Anderson also teaches a way to make waste products into useful particles or pellets for agricultural applications. [*See generally* Ex. 1006 at ¶¶[0002]-[0010].] Since Anderson and Pietsch teach a common goal of using waste products for beneficial purposes, both teach agglomeration of gypsum, both teach agglomeration of minerals for agricultural purposes, and Anderson recognizes that synthetic material can be agglomerated by its process, I would have used synthetic gypsum as taught by Pietsch in the process of Anderson for the purpose of creating useful fertilizer products from synthetic gypsum byproduct.

118. I would have expected to be successful combining synthetic gypsum, which was well known from Pietsch, into the process of Anderson to make a

fertilizer. The prior art of Anderson and Pietsch when taken together teach feeding synthetic gypsum to a forming device. I would have used known methods as taught by Anderson to agglomerate synthetic gypsum as taught by Pietsch, and in so doing, the synthetic gypsum would perform the same function as the gypsum in Anderson, e.g., as a source material for making gypsum-based fertilizer and ultimately to provide nutrients to soil. Moreover, gypsum and synthetic gypsum behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection of the binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material. [See, e.g., Ex. 1012.] Based on the teachings of Anderson and Pietsch, and my own experience, I would have recognized that the results of using synthetic gypsum as taught by Pietsch in the process of Anderson would predictably make gypsum-based fertilizer pellets having the properties described in Anderson and claimed in the '638 Patent.

119. Alternatively or additionally, I would have seen using synthetic gypsum in place of the gypsum or other minerals taught by Anderson as a simple substitution of known elements to yield predictable results. Anderson teaches a method of making fertilizer from gypsum and recognizes that synthetic minerals may be used as source material. To the extent Anderson does not teach making fertilizer from

synthetic gypsum, this was known in the art at least from Pietsch, which teaches using waste product to make fertilizers as well as agglomeration of synthetic gypsum that is a byproduct of FGD processes, as discussed above. Based on the teachings of Anderson and Pietsch, and my own experience, I could have substituted synthetic gypsum as taught by Pietsch in the process of Anderson, which substitution would predictably make gypsum-based fertilizer pellets having the properties described in Anderson and claimed in the '638 Patent. Again, gypsum and synthetic gypsum behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. [*See, e.g.*, Ex. 1012.]

3. Element 1b

120. Anderson renders obvious feeding a binder composition comprising lignosulfonate having 18% to 40% solids to the forming device. Specifically, Anderson teaches “[o]ptionally, at least part of the watersoluble binder may be added to the pelletizing apparatus during pelletizing.” [Ex. 1006 at ¶[0046].] The binder can be “a lignin derivative and is optionally calcium lignosulfonate.” [Ex. 1006 at ¶[0026] (also identifying as an option sodium lignosulfonate).] Anderson further

teaches that the binder is a water based slurry having about 40% to 50% solids by weight. [*Id.* at ¶[0027].] As discussed above for Harrison, I see this as equivalent to the expression of “% solids” in the ‘638 Patent. That is, Anderson’s binder has 40 to 50% solids. This range overlaps the claimed range of 18% to 40% in claim 1 of the ‘638 Patent. Given the overlap, I would have found it obvious to select within the claimed range % solids.

121. Moreover, it was well known before the ‘638 Patent was filed that an agglomeration process can be tuned or optimized by modifying the viscosity of the binder composition, which for lignosulfonate solutions depends on the solids content of the solution, as I explained above (citing Ex. 1016). Binder solutions are commonly diluted and adjusted in practice as is necessary for a given vendor batch of binder to achieve a desirable viscosity for spray atomization, pellet growth and pellet densification. Anderson recognizes as much since it teaches that when the binder is added to the pelletizing apparatus, up to about 15% by weight of additional water “may be necessary for agglomeration.” [Ex. 1006 at ¶[0046].] Accordingly, Anderson recognizes that the binder may have more water and thus be at the lowest end (40% solids) of the range given, or even below it. For example, a 15% by water dilution would give a 34% solids content. I would have found it obvious to select a binder composition with 40% solids, which falls within the claimed range.

4. Element 1c

122. Anderson teaches forming the material fed to the forming device to a mean pellet size guide number (SGN) from approximately 100 to approximately 500. After pelletizing, Anderson teaches the its granules have a size guide number between 100 and 230, which is within the claimed range in claim 1. [Ex. 1006 at ¶[0052].]

5. Element 1d

123. Anderson teaches pelletized synthetic gypsum with a crush strength from approximately 2 lbf to approximately 12 lbf. Anderson teaches its granules have a crush strength between 2 and 8 pounds. As discussed above, I understand a crush strength reported in terms of pounds to be referring to “pounds of force” or “lbf” since it is understood a strength measurement corresponds to a force. Accordingly, Anderson’s granules have a crush strength within the claimed range of approximately 2 to 12 approximately lbf.

B. Claim 11

1. Preamble

124. As discussed above for Element 1a, Anderson teaches a fertilizer.

2. Element 11a

125. As discussed above for similar Element 1a, it is my opinion that the combination of Anderson and Pietsch teaches pellets comprising synthetic gypsum for the same reasons as for Element 1a.

3. Element 11b

126. As discussed above for similar Element 1b, Anderson teaches a lignosulfonate binder composition having about 40% to 50% solids. Given the overlap, I would have found it obvious to select within the claimed range of % solids. Moreover, Anderson teaches that when the binder is added to the pelletizing apparatus, up to about 15% by weight of additional water “may be necessary for agglomeration.” Based on this teaching I would have found it obvious to select a binder composition having 40% solids, which is within the claimed range.

127. Anderson also teaches that “[o]ptionally, at least part of the watersoluble binder may be added to the pelletizing apparatus during pelletizing” and after the admixture comprising gypsum discussed in the preceding section for Element 11a is added to the pelletizer or granulator. [Ex. 1006 at ¶¶[0046]-[0047].] Therefore, the 40 to 50% solids binder composition, or as low as 34% after water dilution, discussed above overlaps the claimed range of 18% to 40% solids in claim 11 of the ‘638 Patent at the time of contact with the gypsum.

4. Element 11c

128. As discussed above for Element 1c, after pelletizing, Anderson teaches the its granules have a size guide number between 100 and 230, which is within the claimed range.

5. Element 11d

129. As discussed above for Element 1d, Anderson teaches its granules have a crush strength between 2 and 8 pounds, which I would understand to mean “pounds of force.” Accordingly, Anderson’s granules have a crush strength within the claimed range of approximately 2 to 12 lbf.

C. Claim 2

130. Anderson teaches synthetic gypsum fed to the forming device having a mean particle size of less than 100 microns. In one example, Anderson teaches gypsum fragments with 100% passing through a 50 mesh screen and 80% or more passing through a 200 mesh screen as the starting material. [Ex. 1006 at ¶[0057] (referring to an example process beginning with limestone particles); ¶[0059] indicating the same process can be performed with gypsum); ¶[0018] (based on the U.S. Standard Sieve sizes).] This corresponds to particles 100% of which are smaller than 297 microns and 80% of which are smaller than 74 microns.

131. An example set of gypsum particles meeting these limitations would have particles falling within these size ranges is 70% at 26 microns, 15% at 53 microns, 10% at 110 microns, and 5% at 220 microns. Based on Anderson’s disclosure, and my own experience, it would have been obvious to select this example set of particles falling within the size ranges taught by Anderson. This set of particles has volume mean diameter of 48 microns and Sauter mean diameter of

32 microns which I calculated in the same way as for claim 2 in Grounds 1 and 2 above and which are both less than 100 microns as in claim 2.

D. Claims 3 and 12

132. As noted above for Elements 1b and 11b, Anderson teaches a water soluble binder.

E. Claim 8

133. As discussed above for Element 1a, Anderson teaches feeding an admixture to pelletizing equipment such as a pelletizing pan.

F. Claim 9

134. As discussed above for Element 1a, Anderson teaches feeding an admixture to granulation equipment such as a drum granulator.

G. Claim 10

135. As shown above for the preambles of claims 1 and 11, Anderson discloses fertilizers made by its method.

GROUND 4 – OBVIOUSNESS OVER VEVERKA IN VIEW OF HARRISON OR PIETSCH

136. It is my opinion that claims 1-3, 5, 7, 8, 10, 11, 12, 14, 16-19, 22, and 23 of the '638 Patent are obvious over Veverka in view of Harrison or Pietsch. I will first address claims 1 and 11 according to the preamble and claims as used above for Grounds 1-3. I will then turn to claim 17.

A. Claim 1

1. Preamble

137. Veverka teaches a method of making fertilizer. Specifically, Veverka teaches the process of agglomerating limestone to make fertilizer pellets. [Ex. 1007 at § 2.]

2. Element 1a

138. Veverka teaches feeding limestone to a forming device. Specifically, Veverka teaches using a screw feeder to feed material to a pin mixer, which is a type of agglomeration equipment, and which “partially agglomerates” the material. [Ex. 1007 at § 4.1 (emphasis added).] The pin mixer is thus a forming device.

139. Veverka does not teach feeding synthetic gypsum to a forming device. However, as discussed above for Grounds 1 and 2, Harrison teaches feeding synthetic gypsum to a forming device to make fertilizer. Moreover, as discussed in this section and in Grounds 1 and 2 above, Veverka and Harrison disclose similar agglomeration processes that employ the same binder and that produces pellets with the same properties (particle size and crush strength). Veverka and Harrison teach a common goal of agglomerating a mineral to make fertilizer, both teach the same method and a finished product with the same properties, and Harrison teaches that its methods are suitable for “gypsum, limestone, or mixtures thereof,” indicating that synthetic gypsum and limestone can be used interchangeably. [Ex. 1005 at 5:23-30.]

140. Given the teachings of Veverka and Harrison and my own experience, I would have used synthetic gypsum as taught by Harrison in the process of Veverka for the purpose of creating useful fertilizer products from synthetic gypsum byproduct. In addition, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection of the binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material. [See, e.g., Ex. 1012.] This further lends itself to the motivation to combine the teachings of Harrison and Veverka.

141. I would have expected to be successful combining synthetic gypsum, which was well known from Harrison, into the process of Veverka to make a fertilizer. The prior art of Veverka and Harrison when taken together teach feeding synthetic gypsum to a forming device. I would have used known methods as taught by Veverka to agglomerate synthetic gypsum as taught by Harrison, and in so doing, the synthetic gypsum would perform the same function as the limestone in Veverka, e.g., as a source material for making fertilizer and ultimately to provide nutrients to soil. Also, again, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the

selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. [*See, e.g.*, Ex. 1012.] Based on the teachings of Veverka and Harrison, and my own experience, I would have recognized that the results of using synthetic gypsum as taught by Harrison in the process of Veverka would predictably make gypsum-based fertilizer pellets having the properties described in Veverka and claimed in the '638 Patent.

142. Alternatively or additionally, I would have seen using synthetic gypsum in place of the limestone taught by Veverka as a simple substitution of known elements to yield predictable results. Making fertilizer from synthetic gypsum was known in the art at least from Harrison, which teaches agglomeration of synthetic gypsum to make fertilizer, as discussed above. Based on the teachings of Veverka and Harrison, and my own experience, I could have substituted synthetic gypsum as taught by Harrison in the process of Veverka, which substitution would predictably make gypsum-based fertilizer pellets having the properties described in Veverka and claimed in the '638 Patent. Again, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration

equipment) and less so based on the chemical makeup of the source material alone.
[See, e.g., Ex. 1012.]

143. Alternatively, as discussed above in Ground 3, Pietsch teaches using waste product to make fertilizers as well as agglomeration of synthetic gypsum that is a byproduct of FGD processes. Since Veverka and Pietsch both teach agglomeration of minerals to make fertilizer, and Pietsch teaches the benefit of using synthetic gypsum byproduct, I would have been motivated to use synthetic gypsum as taught by Pietsch in the process of Veverka for the purpose of creating useful fertilizer products from synthetic gypsum byproduct.

144. Given the teachings of Veverka and Pietsch, and my own experience, I would have expected to be successful combining synthetic gypsum, which was well known from Pietsch, into the process of Veverka to make a fertilizer. Moreover, as discussed above, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection of the binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material. [See, e.g., Ex. 1012.] This further lends itself to the motivation to combine the teachings of Pietsch and Veverka.

145. Alternatively or additionally, I would have seen using synthetic gypsum as taught by Pietsch in place of the limestone taught by Veverka as a simple substitution of known elements to yield predictable results. Using waste product to make fertilizers as well as agglomeration of synthetic gypsum was known in the art at least from Pietsch, as discussed above. In addition, again, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. [See, e.g., Ex. 1012.] Based on the teachings of Veverka and Pietsch, and my own experience, I could have substituted synthetic gypsum as taught by Pietsch in the process of Veverka, which substitution would predictably make gypsum-based fertilizer pellets having the properties described in Veverka and claimed in the '638 Patent.

146. Moreover, Harrison teaches that its methods are suitable for “gypsum, limestone, or mixtures thereof,” indicating that synthetic gypsum and limestone can be used interchangeably. [Ex. 1005 at 5:23-30.] Given these teachings even aside from my own experience and those of Pietsch and Veverka discussed above, I would have expected to be successful using synthetic gypsum as taught by Pietsch into the

process of Veverka to make a fertilizer as evidenced by Harrison. Alternatively or additionally, I would have seen using synthetic gypsum as taught by Pietsch in place of the limestone taught by Veverka as a simple substitution of known elements to yield predictable results based on these teachings of Harrison.

3. Element 1b

147. Veverka teaches feeding a binder composition comprising lignosulfonate having 18% to 40% solids to the forming device. Veverka teaches several binder options, two of which are lignosulfonate solutions. [*Id.* at Table 7.1 and 7.2, Binder #1 and Binder #2.] Binder #1 was obtained from the manufacturer at 52.0% solids and Binder #2 was obtained from the manufacturer at 57.4% solids. [*Id.* at Table 7.2.] Before being used in the pelletization process, Binder #1 was diluted at a rate of 38% binder to 62% water to make a 19.76% solids binder composition. [*Id.* at Table 4.4.1 (teaching “set-up parameters”); *see also* § 4.1 (describing batch mixing binder with water prior to pelletization).] Binder #2 was diluted at a rate of 35% binder to 65% water to make a 20.09% solids binder composition. [*Id.*] Both Binder #1 and Binder #2 as diluted fall within the claimed range of 18% to 40% solids in claim 1 of the ‘638 Patent. The diluted binders were fed to the forming device (the pin mixer) by spraying. [*Id.* at § 4.1.]

4. Element 1c

148. After feeding synthetic gypsum and lignosulfonate binder into the granulator, Veverka teaches forming the mixture to a mean pellet size guide number (SGN) from approximately 100 to approximately 500. Veverka teaches “acceptable particle size is considered to be passing through 4 mesh but retained on 20 mesh,” which corresponds to particles sizes between 0.841 mm and 4.76 mm. With the majority of the material (at least 50 % by weight) passing through 4 mesh but retained on 20 mesh, the median diameter of wet pellets would lie between 0.841 mm and 4.76 mm, and SGN between 84 and 476. [Ex. 1011.] Given the overlap, I would have found it obvious to select within the claimed range.

5. Element 1d

149. Veverka as combined with Harrison or Pietch as discussed above for Element 1a renders obvious a pelletized synthetic gypsum with a crush strength of approximately 2 lbf to approximately 12 lbf. Veverka teaches that the fertilizer pellets should have a crush strength of 4.0 # (which is a symbol for pounds (lbs) and, as discussed above for Harrison and Anderson, I would take to mean pounds of force). [Ex. 1007 at § 6.1.4.] This falls within the approximately 2 lbf to approximately 12 lbf range in claim 1 of the ‘638 Patent.

B. Claim 11

1. Preamble

150. As discussed above for the preamble of claim 1, Veverka teaches a fertilizer.

2. Element 11a

151. As discussed above for similar Element 1a, it is my opinion that the combination of Veverka and Harrison or Pietsch teaches pellets comprising synthetic gypsum for the same reasons as for Element 1a.

3. Element 11b

152. As discussed above for similar element 11b, Veverka teaches Binder #1 diluted at a rate of 38% binder to 62% water to make a 19.76% solids binder composition and Binder #2 diluted at a rate of 35% binder to 65% water to make a 20.09% solids binder composition prior to being contacted with the limestone during pelletization. Both Binder #1 and Binder #2 fall within the claimed range of 18% to 40% solids in claim 11 of the '638 Patent.

4. Element 11c

153. As discussed above for Element 1c, Veverka teaches "acceptable particle size is considered to be passing through 4 mesh but retained on 20 mesh," which corresponds to particles sizes between 0.841 mm and 4.76 mm. With the majority of the material (at least 50 % by weight) passing through 4 mesh but retained on 20 mesh, the median diameter of wet pellets would lie between 0.841

mm and 4.76 mm, and SGN between 84 and 476. Given the overlap, I would have selected within the claimed range of in claim 1 of the '638 Patent.

5. Element 11d

154. As discussed above for Element 1d, Veverka teaches that the fertilizer pellets should have a crush strength of 4.0 #, which falls within the approximately 2 lbf to approximately 12 lbf range in claim 11 of the '638 Patent.

C. Claim 17

155. Claim 17 recites a preamble and six elements which I will denote as follows:

[Preamble] 1. A process for producing a fertilizer comprising:

[17a] feeding synthetic gypsum to a dryer;

[17b] feeding dried synthetic gypsum and a binder composition comprising lignosulfonate having 18% to 40% solids to a mixer; mixing the material fed to the mixer;

[17c] feeding the mixed material to a forming device; **p**elletizing the material fed to the forming device;

[17d] feeding the pelletized material to a dryer; drying the pelletized material;

[17e] feeding the dried pelletized material to a screener; and screening the material fed to the screener to a mean pellet size guide number (SGN) from approximately 100 to approximately 500, wherein

[17f] the resulting pelletized synthetic gypsum has crush strength from approximately 2 lbf to approximately 12 lbf.

1. Preamble

156. As discussed above for the preamble of claim 1, Veverka teaches a process for making fertilizer.

2. *Element 17a*

157. Veverka does not teach feeding synthetic gypsum to a dryer. However, Veverka in view of Pietsch renders obvious feeding synthetic gypsum to a dryer. Pietsch teaches using waste product to make fertilizers as well as agglomeration of synthetic gypsum that is a byproduct of FGD processes. [Ex. 1003 at 37-39; *see also* 19-20.] Pietsch further teaches that the product from FGD processes is a slurry which is mechanically dewatered to produce a filter cake of finely divided synthetic gypsum solids. [Ex. 1003 at 39.] Pietsch further teaches drying the finely divided synthetic gypsum solids before converting them into other products by agglomeration. [*Id.* at 39-40.] Peitsch teaches numerous examples of dryers for drying particular material including for the purpose of recycling or using up secondary/byproduct materials such as FGD gypsum. [*See, e.g., Id.* at 65-70.] Moreover dryers are well-known in the area of agglomeration and I would have known how to select a dryer of many known options for drying the finely divided synthetic gypsum solids before converting them into other products by agglomeration.

158. Since Veverka and Pietsch both teach agglomeration of minerals to make fertilizer, and Pietsch teaches the benefit of using synthetic gypsum byproduct, I would have been motivated to use synthetic gypsum as taught by Pietsch in the process of Veverka to create useful fertilizer products from synthetic gypsum

byproduct. Moreover, I would have been motivated to dry the synthetic gypsum prior to the other processing steps taught by Veverka because doing so improves the portability and handling properties of the synthetic gypsum, making it easier to transport and work with.

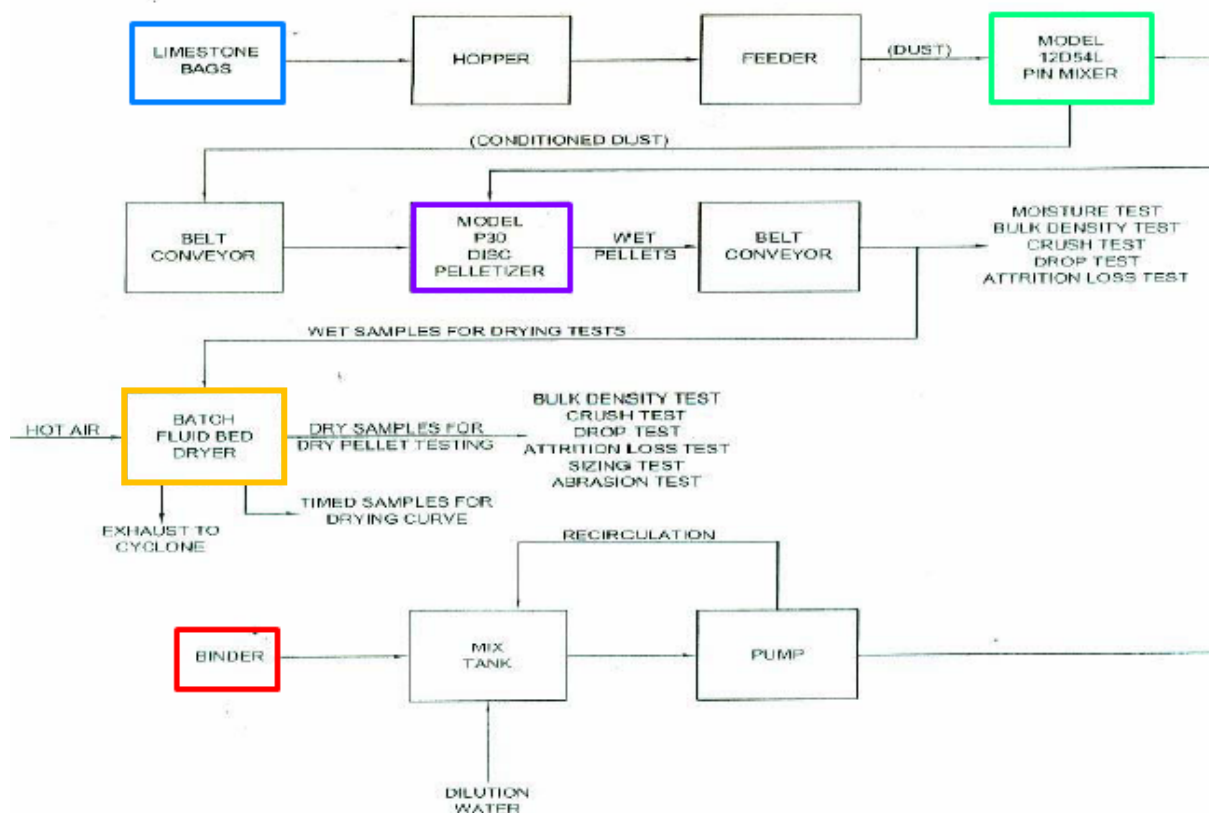
159. Given the teachings of Veverka and Pietsch, and my own experience, I would have expected to be successful combining synthetic gypsum, which was well known from Pietsch, into the process of Veverka to make a fertilizer, and drying the synthetic gypsum as taught by Pietsch. As discussed above, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. Therefore I would have expected the dried synthetic gypsum as taught by Pietsch to work in the process of Veverka.

160. Moreover, as discussed above, Harrison teaches that its methods are suitable for “gypsum, limestone, or mixtures thereof,” indicating that synthetic gypsum and limestone can be used interchangeably. [Ex. 1005 at 5:23-30.] I would have expected to be successful using synthetic gypsum as taught by Pietsch into the

process of Veverka, and drying the synthetic gypsum as taught by Pietsch, to make a fertilizer as evidenced by Harrison.

3. Element 17b

161. Veverka as modified by Pietsch for Element 17a discussed above teaches feeding dried synthetic gypsum and a binder composition comprising lignosulfonate having 18% to 40% solids to a mixer and mixing the material. Veverka teaches feeding its limestone feed material (blue) and binder (red) to a pin mixer (green) to partially agglomerate the particles as shown in annotated Figure 1 below:



[See also Ex. 1007 at § 4.1.]

162. As discussed above for similar Elements 1b and 11b, Veverka teaches two example lignosulfonate binders: Binder #1 diluted at a rate of 38% binder to 62% water to make a 19.76% solids binder composition and Binder #2 diluted at a rate of 35% binder to 65% water to make a 20.09% solids binder composition. [*Id.*] Both Binder #1 and Binder #2 as diluted fall within the claimed range of 18% to 40% solids in claim 17 of the ‘638 Patent.

4. Element 17c

163. Veverka teaches feeding the mixed material to a forming device and pelletizing the material fed to the forming device. The forming device is a disc pelletizer shown in purple in annotated Figure 1 above. [*See also* Ex. 1007 at § 4.1.] A pelletizer is a type of forming device as I discussed above and as is recognized in the specification of the ‘638 Patent. [Ex. 1001 at 2:14-16 (“...a forming device, which may comprise a pelletizer, granulator, or extruder”), claim 8 (“wherein the forming device comprises a pelletizer”).] Veverka teaches “tumble growth agglomeration” in the pelletizer, which is a form of pelletization.

5. Element 17d

164. Veverka teaches feeding the pelletized material to a dryer and drying the pelletized material. The dryer is shown in orange in annotated Figure 1 above. [*See also* Ex. 1007 at § 4.1.]

6. Element 17e

165. Veverka teaches feeding the dried pelletized material to a screener. Specifically, Veverka teaches screening its pellets and that screening was accomplished by placing the pellets on a screen and agitating, which I take to mean the screening was performed in a screener. [Ex. 1007 at §§ 4.1, 4.2.] Veverka also teaches screening the material fed to the screener to a mean pellet size guide number (SGN) from approximately 100 to approximately 500, which corresponds to particles with median or 50 percent diameter size between 0.841 and 4.75 mm, or SGN of 84-475, as discussed above for similar Elements 1c and 11c. [*Id.* at § 4.1.] These particles have a median particle size overlapping the claimed range. Given the overlap, I would have found it obvious to select within the claimed range of average particle size.

7. Element 17f

166. Veverka teaches the resulting pellets have crush strength of 4#, or pounds of force, which is between approximately 2 lbf to approximately 12 lbf as discussed above for similar elements 1d and 11d.

D. Claims 2 and 19

167. Veverka in view of Harrison renders obvious synthetic gypsum fed to the forming device (for claim 2) or mixer (for claim 19) has a mean particle size of less than 100 microns. Veverka teaches source limestone material with particle size distribution similar to the distribution taught by Harrison. For instance, Veverka

teaches in one example about 50% of the source material is retained on 200 mesh screen and in another example almost 40% of the source material is retained on 200 mesh screen. [Ex. 1007 at §§ 7.3-7.4.] Harrison teaches in one example that its source material has 35 to 50% particles that are plus 200 mesh, meaning those particles are retained on the 200 mesh. [Ex. 1005 at (17:19-26 (referring to 13:11-14); Ex. 1011.] As discussed above for claim 2 in Grounds 1 and 2, Harrison teaches or renders obvious a synthetic gypsum feedstock with mean particle size of less than 100 microns.

168. Since Veverka and Harrison start with similarly sized particles, I would have used the synthetic gypsum feedstock taught by Harrison in the process of Veverka for the same reasons discussed above for Elements 1a and 11a.

E. Claims 3 and 12

169. As discussed above for Elements 1b and 11b, Veverka uses lignosulfonate binder compositions. Lignosulfonate is a water soluble binder.

F. Claims 5 and 14

170. Veverka in view of Harrison renders obvious feeding an additive to the forming device, wherein the additive is selected from the group consisting of ground calcium carbonate, calcium bentonite, kaolin clays, manganese, zinc, boron, calcium, copper, and elemental sulfur. As discussed above for claims 5 and 14 in Grounds 1 and 2, Harrison teaches using a combination of synthetic gypsum and limestone (which is calcium carbonate) in the forming device.

171. Based on the teachings of Harrison, on my own experience, and in view of the fact that Veverka teaches pelletizing limestone to make fertilizer by the same process of Harrison and with the same resulting material properties, I would have expected to be successful using a combination of synthetic gypsum and a limestone additive as taught by Harrison in the process of Veverka to make a fertilizer for the same reasons discussed above for Elements 1a and 11a. Alternatively or additionally, I would have seen using a combination synthetic gypsum and a limestone additive in the process taught by Veverka as a simple substitution of known elements to yield predictable results for the same reasons discussed above for Elements 1a and 11a.

G. Claims 7, 16, and 22

172. Veverka in view of Harrison teaches pellets with mean SGN from approximately 250 to approximately 280. As discussed above for Elements 1c, 11c, and 17e, Veverka specifically teaches “acceptable particle size is considered to be passing through 4 mesh but retained on 20 mesh,” which corresponds to particles with a median size between 0.841 mm and 4.76 mm and SGN between 84 and 476.

173. As discussed above for claim 2 in Ground 2, Harrison teaches that some portion of the product used for crush strength testing in Example II falls within the Tyler Standard Screen Scale size range of minus 7 plus 8 mesh, which corresponds to particle sizes ranging from 2.38 to 2.83 mm or SGN 238 and 283. This is within

the range of particle sizes taught by Veverka and which I take to be equivalent to the claimed SGN range of approximately 250 to approximately 280.

174. Given the teachings of Harrison and my own experience, I would have expected to be successful in isolating the narrower range particle fertilizer size taught by Harrison in the process of Veverka since both teach pelletizing minerals with lignosulfonate binder to make fertilizer, and the resulting fertilizers have the same crush strength as discussed for Grounds 1 and 2 above and in this Ground 4. Moreover, the claimed range of SGN 250 to 280 falls within the range of particle sizes that Harrison teaches are suitable for fertilizer which I address above. [Ex. 1005 at 11:65-12:31.]

H. Claim 8

175. As shown above for Element 1a, Veverka uses a pin mixer, which is a type of pelletizer.

I. Claims 10 and 23

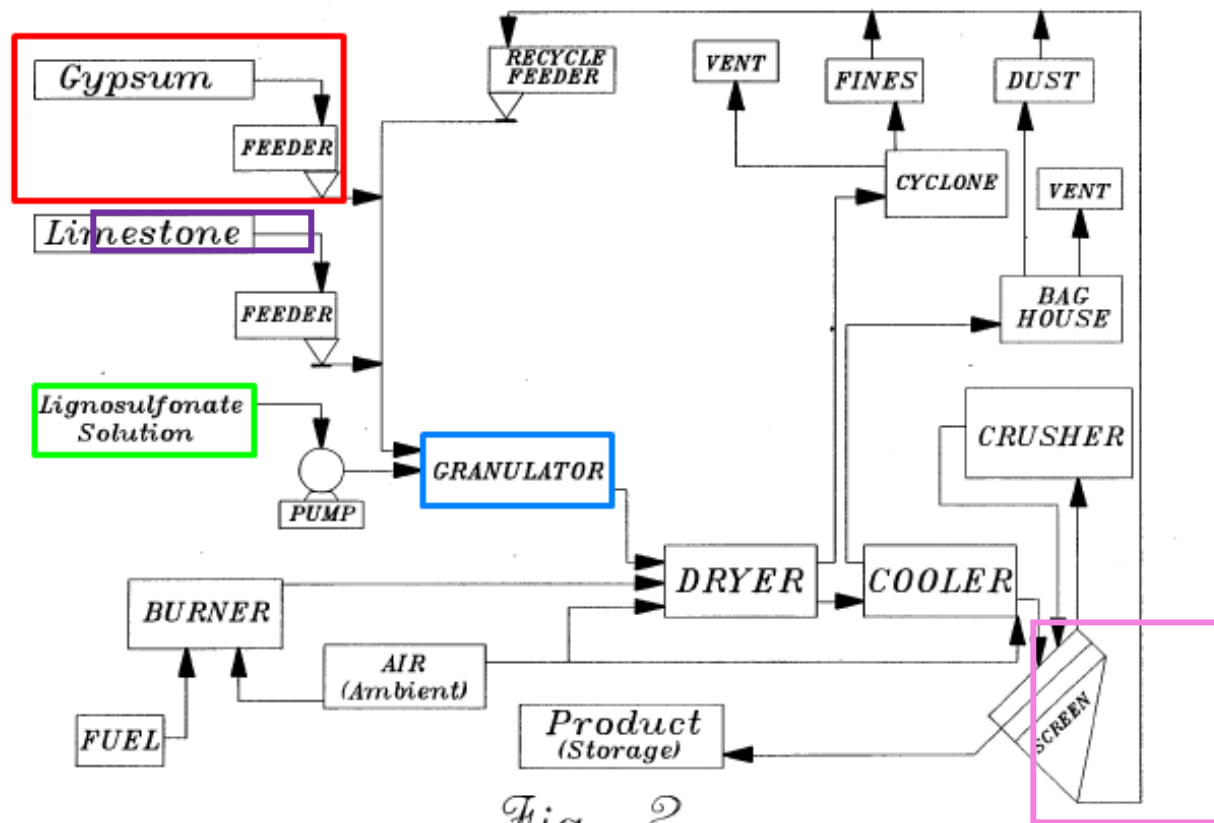
176. As shown above for the preambles of claims 1 and 17, Veverka discloses fertilizers made by its method.

J. Claim 18

177. Veverka in view of Harrison renders obvious recycling unders and overs removed during screening to the mixer. Veverka teaches that in a pelletizing process, “[o]ff-size material must be handled through a recycle material handling system or disposed.” [Ex. 1007 at § 6.3.] Thus Veverka contemplates recycling off-

size material, which would I understand to be “unders and overs” or in other words, under- and over-sized particles.

178. Harrison teaches a screener (shown in pink in annotated Figure 2 below). Harrison further teaches that oversize material is crushed and re-screened in the screener. [Ex. 1005 at 8:9-14.] Undersize material from the granulator and the crusher are both recycled to the granulator. [*Id.* at 8:14-21; *see also* 10:40-52, 11:13-16, 12:30-36.] Since Veverka already contemplates recycling, and Harrison describes a similar process with similar resulting fertilizer particles as Veverka, addressed in more detail above and throughout this section, I would have been motivated to implement recycling as suggested by Veverka in the manner taught by Harrison for the purpose of reducing waste in the pelletization process.



GROUND 5 – OBVIOUSNESS OVER SHIMADA IN VIEW OF HARRISON OR VEVERKA

179. It is my opinion that claims 1-5, 7, 9-14, and 16 of the '638 Patent are obvious over Shimada and Harrison. I will refer to the same elements as discussed above in Grounds 1-4.

A. Claim 1

1. Preamble

180. Shimada teaches a method for making fertilizer. [Ex. 1009 at ¶¶[0007]-[0008].]

2. Element 1a

181. Shimada teaches feeding synthetic gypsum to a forming device. Specifically, Shimada teaches using a drum-type granulator to granulate synthetic gypsum such as by-product gypsum. [*Id.* at ¶¶[0014], [0019], [0049].] A granulator is a type of forming device as I explained above and as recognized in the specification of the ‘638 Patent. [Ex. 1001 at 2:14-16 (“...a forming device, which may comprise a pelletizer, granulator, or extruder”), claim 9 (“wherein the forming device comprises a granulator or extruder”).]

3. Element 1b

182. Shimada in view of Harrison renders obvious a binder composition comprising lignosulfonate, wherein the binder composition initially has 18% to 40% solids at the time of contact with the synthetic gypsum. Shimada teaches using a composition with lignosulfonate as a “granulation aid” for its process. [*Id.* at ¶¶[0011], [0049].] To me, “granulation aid” is another term for binder. The granulation aid is added to the granulator with the gypsum. [Ex. 1009 at ¶[0019].] Shimada does not disclose a solids content for its granulation aid. Shimada does teach, however, adding water to the granulator along with the gypsum and granulation aid. [*Id.*]

183. As discussed above for Grounds 1 and 2, Harrison teaches or renders obvious feeding a binder composition comprising lignosulfonate having 18% to 40%

solids to a forming device for agglomerating synthetic gypsum. Since Harrison and Shimada both teach using synthetic gypsum and lignosulfonate binder to agglomerate fertilizer, use the same type of agglomeration equipment (a granulator), and make fertilizers with the same material properties (particle size and crush strength) as will be discussed in this Ground and is discussed for Grounds 1 and 2 above, I would have used a lignosulfonate binder having the solids content taught by Harrison in the process of Shimada.

184. I would have expected to be successful using a lignosulfonate binder having the solids content taught by Harrison in the process of Shimada. The prior art of Shimada and Harrison when taken together teach a binder composition comprising lignosulfonate, wherein the binder composition initially has 18% to 40% solids at the time of contact with the synthetic gypsum. I would have used known methods as taught by Shimada and Harrison to agglomerate synthetic gypsum, and in so doing, the binder taught by Harrison would perform the same function as the granulation aid in Shimada, e.g., as a binder to hold the synthetic gypsum together in the fertilizer pellets. Based on the teachings of Shimada and Harrison, and my own experience, I would have recognized that the results of using the solids content for the binder composition taught by Harrison in the process of Shimada would predictably make gypsum-based fertilizer pellets having the properties described in Shimada and claimed in the '638 Patent. Moreover, it was well known before the

'638 Patent was filed that an agglomeration process can be tuned or optimized by modifying the viscosity of the binder composition, which for lignosulfonate solutions depends on the solids content of the solution, as I explained above (citing Ex. 1016). Therefore I would have selected a binder with a particular solids content as taught by Harrison for use in the process of Shimada.

185. Alternatively or additionally, I would have seen using the binder taught by Harrison in place of the granulation aid taught by Shimada as a simple substitution of known elements to yield predictable results. Based on the teachings of Shimada and Harrison, and my own experience, doing so would predictably make gypsum-based fertilizer pellets having the properties described in both Shimada and Harrison, and claimed in the '638 Patent. Again, Shimada and Harrison's process are nearly identical save for the binder composition, and produce the same fertilizer products with the same material properties.

4. Element 1c

186. Shimada teaches forming the mixture to a mean pellet size guide number (SGN) from approximately 100 to approximately 500. Shimada teaches its fertilizer has particle size from 1 to 4 mm. With the majority of the material (at least 50 % by weight) between 1 to 4 mm, the median diameter of particles would lie between 1 mm and 4 mm, which corresponds to SGN between 100 and 400. [Ex. 1009 at ¶¶[0019], [0030].] In a particular example Shimada teaches gypsum and

lignosulfonate particles having particles size 2 mm to 4 mm which, by the same argument, would correspond to an SGN between 200 and 400. [*Id.* at ¶[0049].] Both ranges taught by Shimada fall within the claimed range.

5. Element 1d

187. Shimada's fertilizer renders obvious a pelletized synthetic gypsum with a crush strength of approximately 2 lbf to approximately 12 lbf. Shimada teaches its fertilizer has average hardness of 1kg/grain (when converted to pounds, 2.2lb/grain) or more. [Ex. 1009 at ¶[0020].] I understand "average hardness" to correspond to crush strength, and further assume that the kg or, as converted to pounds, refers to kg or pounds of force. This overlaps the approximately 2 lbf to approximately 12 lbf range in claim 1 of the '638 Patent. Given the overlap, I would have found it obvious to select within the claimed range of crush strength.

B. Claim 11

1. Preamble

188. As discussed above for the preamble of claim 1, Shimada teaches a fertilizer.

2. Element 11a

189. As discussed above for similar Element 1a, Shimada teaches granulating synthetic gypsum such as by-product gypsum to make pellets.

3. Element 11b

190. As discussed above for similar Element 1b, Shimada teaches using a composition with lignosulfonate as a binder for its process. I understand a granulation aid to be a binder composition. Shimada does not disclose a solids content for its binder composition, however, I would have used the teachings of Harrison as to solids content for the binder in the process of Shimada for the same reasons as discussed above for Element 1b.

4. Element 11c

191. As discussed above for Element 1c, Shimada teaches its fertilizer has particle size from 1 to 4 mm, which as describe earlier, corresponds to an SGN between 100 to 400. In a particular example Shimada teaches gypsum and lignosulfonate particles having particles size 2 mm to 4 mm, which as described earlier, corresponds to an SGN between 200 to 400. Both teachings fall within the claimed range of SGN between 100 to 500 in claim 11 of the '638 Patent.

5. Element 11d

192. As discussed above for Element 1d, Shimada teaches its fertilizer has crush strength of 1kg/grain (2.2lb/grain) or more, which overlaps the approximately 2 lbf to approximately 12 lbf range in claim 11 of the '638 Patent. Given the overlap, I would have found it obvious to select within the claimed range of crush strength.

C. Claim 2

193. Shimada in view of Harrison renders obvious that the synthetic gypsum fed to the forming device has a mean particle size of less than 100 microns. Shimada is silent as to the particle size of the synthetic gypsum fed to the forming device. As discussed above for claim 2 in Ground 1, Harrison teaches or renders obvious synthetic gypsum having mean particle size of less than 100 microns fed to the forming device. I would have known to use the gypsum feedstock taught by Harrison in the process of Shimada since Harrison and Shimada teach nearly identical processes that make the same fertilizer products as discussed above for Elements 1b and 11b.

194. I would have expected to be successful using the feedstock taught by Harrison in the process of Shimada. The prior art of Shimada and Harrison when taken together teach that the synthetic gypsum fed to the forming device has a mean particle size of less than 100 microns. I would have used known methods as taught by Shimada and Harrison to agglomerate synthetic gypsum, and in so doing, the feedstock taught by Harrison would perform the same function as the feedstock in Shimada, e.g., as a source material for making synthetic gypsum pellets fertilizer pellets. Based on the teachings of Shimada and Harrison, and my own experience, I would have recognized that the results of using the feedstock with particle size taught by Harrison in the process of Shimada would predictably make gypsum-based

fertilizer pellets having the properties described in Shimada and Harrison, and claimed in the '638 Patent.

D. Claims 3 and 12

195. Shimada teaches that its binder composition comprises a water soluble binder. As discussed above for Elements 1b and 11b, Shimada uses a binder composition comprising lignosulfonate, which is a water soluble binder.

E. Claims 4 and 13

196. Claim 4 depends from claim 1 and recites “wherein the binder composition also comprises one or more binders selected from the group of...starch.” Claim 13 depends from claim 11 and recites the same. Shimada teaches a granulation aid or binder that can include at least one of several options which include lignosulfonates and starches. [Ex. 1008 at ¶[0011]]. Based on this teaching I understand that Shimada contemplates the use of a combination of lignosulfonate and starch.

F. Claims 5 and 14

197. As discussed above for claims 5 and 14 in Grounds 1, 2, and 4, Harrison teaches using a combination of limestone and synthetic gypsum for its source material. Based on the teachings of Harrison, and in view of the fact that Shimada and Harrison both teach granulating gypsum with lignosulfonate to make fertilizers with the same resulting material properties, I would have used the limestone/gypsum

combination feedstock as taught by Harrison in the process of Shimada for similar reasons as discussed above for Elements 1b and 11b.

198. I would have expected to be successful using the feedstock taught by Harrison in the process of Shimada. The prior art of Shimada and Harrison when taken together teach using a combination of limestone and synthetic gypsum for its source material. I would have used known methods as taught by Shimada and Harrison to agglomerate synthetic gypsum, and in so doing, the feedstock taught by Harrison would perform the same function as the feedstock in Shimada, e.g., as a source material for making fertilizer pellets. Based on the teachings of Shimada and Harrison, and my own experience, I would have recognized that the results of using the combination gypsum/limestone feedstock taught by Harrison in the process of Shimada would predictably make fertilizer pellets having the properties described in Shimada and Harrison, and claimed in the '638 Patent. Gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. [See, e.g., Ex. 1012.] Harrison even teaches that its methods

are suitable for “gypsum, limestone, or mixtures thereof,” indicating that synthetic gypsum and limestone can be used interchangeably. [Ex. 1005 at 5:23-30.]

199. Alternatively or additionally, I would have seen using the combination gypsum/limestone feedstock taught by Harrison in place of the synthetic gypsum feedstock as taught by Shimada as a simple substitution of known elements to yield predictable results. Based on the teachings of Shimada and Harrison, and my own experience, I could have substituted using the combination gypsum/limestone feedstock taught by Harrison in the process of Shimada, which substitution would predictably make fertilizer pellets having the properties described in Shimada and Harrison, and claimed in the ‘638 Patent. Again, gypsum and limestone behave very similarly in agglomeration processes, and in any case, the result of an agglomeration process is largely related to the processing conditions (such as the particle size of the source material, the selection and properties of a compatible binder, the amount of water or liquid supplied during the process, and the operation of the agglomeration equipment) and less so based on the chemical makeup of the source material alone. [See, e.g., Ex. 1012.] Harrison even teaches that its methods are suitable for “gypsum, limestone, or mixtures thereof,” indicating that synthetic gypsum and limestone can be used interchangeably. [Ex. 1005 at 5:23-30.]

G. Claims 7 and 16

200. Shimada in view of Harrison renders obvious that its pellets have mean SGN is from approximately 250 to approximately 280. As discussed above for Elements 1c, 11c, and 17c, Shimada teaches its fertilizer has particle size from 1 to 4 mm (which as described above corresponds to an SGN between 100 and 400). In a particular example Shimada teaches gypsum and lignosulfonate particles having particles size 2 mm to 4 mm (which as described above corresponds to an SGN between 200 and 400).

201. Harrison teaches that some portion of the product in Example II falls within the Tyler Standard Screen Scale size range of minus 7 plus 8 mesh, which corresponds to particle sizes ranging from 2.38 to 2.83 mm or SGN of 238 to 283. [Ex. 1005 at 13:38-49, Table 1; Ex. 1011.] This range is equivalent to the claimed range of approximately 250 to approximately 280 for SGN in claims 7 and 19. Given the teachings of Harrison and my own experience, I would have expected to be successful in isolating the narrower range particle fertilizer size taught by Harrison in the process of Shimada since both teach pelletizing minerals with lignosulfonate binder to make fertilizer, and the resulting fertilizers have the same material properties (particle size and granulation strength) as discussed in this section and for Grounds 1 and 2 above and in this Ground 5. Moreover, the claimed range of SGN

250 to 280 falls within the range of particle sizes that Harrison teaches are suitable for fertilizer. [Ex. 1005 at 11:65-12:31.]

H. Claim 9

202. Shimada teaches that its forming device comprises a granulator or extruder. As shown above for Element 1a, Shimada uses a drum granulator.

I. Claim 10

203. Shimada teaches a fertilizer made by its process, as shown above for the preamble of claim 1.

GROUND 6 – OBVIOUS IN FURTHER VIEW OF ZANUCCOLI

204. It is my opinion that Zanuccoli renders obvious claims 5, 6, 14, 15, 20 and 21 of the ‘638 Patent in combination with the prior art referenced in any of the preceding grounds.

205. Claim 5 depends from claim 1 and recites “further comprising feeding an additive to the forming device, wherein the additive is selected from the group consisting of ground calcium carbonate, calcium bentonite, kaolin clays, manganese, zing, boron, calcium, copper, and elemental sulfur.” Claim 6 depends from claim 5 and further recites “wherein the additive comprises elemental sulfur.” Claims 14 and 15 depend from claim 11 and are otherwise identical to claims 5 and 6. Claim 20 depends from claim 17 and similarly recites an additive selected from the group consisting of manganese, zing, boron, calcium, copper, and elemental sulfur. Claim

21 depends from claim 17 and like claims 6 and 15 recites that the additive is elemental sulfur.

206. Zanuccoli teaches pellets containing fly sulfur powder and a wetting agent (or binder) which is preferably a lignosulfonate. [Ex. 1011 at 1:20-30, 2:18-38, 3:26-38.] Fly sulfur powder consists of elemental sulfur. The pellets taught by Zanuccoli can also comprise gypsum. [*Id.* at 3:39-41.] Zanuccoli further teaches that in a fertilizer, sulfur provides the benefit of correcting alkalinity of soil and intervening with sodium-calcium ionic exchange. [*Id.* at 1:31-45.]

207. Given the teachings of Zanuccoli, I would have added elemental sulfur as taught by Zanucolli to any of the fertilizers taught by Harrison (Grounds 1 and 2), Anderson in view of Pietsch (Ground 3), Veverka in view of Harrison or Pietsch (Ground 4), or Shimada in view of Harrison (Ground 5).

208. I would have been motivated to add elemental sulfur to the fertilizers taught by Harrison, Anderson in view of Pietsch, Veverka in view of Pietsch or Harrison, or Shimada in view of Harrison for the purpose of correcting alkalinity of soil and intervening with sodium-calcium ionic exchange as taught by Zanucolli. [*Id.* at 1:31-45.] In addition, I would have expected to be successful in adding elemental sulfur to the fertilizers Harrison, Anderson in view of Pietsch, Veverka in view of Pietsch or Harrison, or Shimada in view of Harrison because Zanucolli teaches that

the combination of gypsum and sulfur is possible, beneficial, and useful, and further teaches making its pellets with the same binder (lignosulfonate).

I declare under the penalty of perjury that the foregoing is true and correct.
Executed this 28th day of November, 2023.

A handwritten signature in black ink, appearing to read 'B. Ennis', with a stylized flourish extending to the right.

Bryan J. Ennis, Ph.D.