

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VIANCE, LLC,
Petitioner,
v.

KOPPERS PERFORMANCE CHEMICALS, INC.,
Patent Owner.

Case PGR2026-00023
Patent 12,370,716

**DECLARATION OF CRAIG R. MCINTYRE, PH.D., IN SUPPORT OF
PATENT OWNER'S PRELIMINARY RESPONSE**

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LISTING OF EXHIBITS

Exhibit	Description
Ex. 2013	Curriculum Vitae of Craig R. McIntyre, Ph.D.
Ex. 2017	Kathon™ 287T PRN 98-10 Notification
Ex. 2018	Update on Research with Non-Metal Based Wood Preservative Systems, CWPA Proceedings, 2009
Ex. 2019	EPA Risk Evaluation for Methylene Chloride
Ex. 2020	Montreal Protocol on Substances that Deplete the Ozone Layer
Ex. 2021	OSHA Limits on Methyl Chloroform

I, Craig R. McIntyre, Ph.D., hereby declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Koppers Performance Chemicals, Inc. (“Patent Owner”) to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 12,370,716 (“the ’716 Patent”), titled “Wood Preservative Composition Comprising 4,5-Dichloro-2-Octylisothiazol-3(2H)-One, a Method of Treating a Wood Substrate Therewith, and a Wood Product Produced Therefrom,” to Kuang et al., and that the ’716 Patent is currently assigned to Patent Owner.

2. I understand that Viance, LLC (“Petitioner”) has filed a Petition for Post Grant Review of U.S. Patent No. 12,370,716 (“Petition”) challenging the validity of claims 1–27 of the ’716 Patent (“Challenged Claims”) on multiple grounds, including anticipation and obviousness under 35 U.S.C. §§ 102 and 103, and lack of written description, lack of enablement, and indefiniteness under 35 U.S.C. § 112.

3. In preparing this declaration, I have reviewed and am familiar with all the references cited herein. I have reviewed and am familiar with the ’716 Patent and its file history, the Petition, and all exhibits cited in the Petition. I confirm that to the best of my knowledge exhibits 2017–2021 are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to

formulate opinions such as those set forth in this declaration. I have relied on my education, knowledge, training, and over five decades of experience in the relevant art in forming the opinions expressed herein.

4. The '716 Patent describes a wood preservative composition comprising 4,5-dichloro-2-octylisothiazol-3(2H)-one ("DCOI") and a retaining additive comprising a wax, a method of treating a wood substrate therewith, and a wood product produced therefrom.

5. I am familiar with the technology described in the '716 Patent and state of the art as of the '716 Patent's earliest possible effective priority date of August 5, 2021, and its filing date of March 6, 2025. The effective filing date of the '716 Patent is August 5, 2021.

6. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the '716 Patent and the references that form the basis for the grounds set forth in the Petition.

II. QUALIFICATIONS

7. I have over 50 years of extensive experience with wood preservatives and fire retardants. My expertise includes biocides (pressure and non-pressure application), fire retardants, formulation development, wood treatment processes, wood chemistry, standardized testing, basic research, wood adhesives, code and

regulatory issues, building systems, distribution and transmission poles, and quality control.

8. I received my Bachelor of Science degree in Chemistry from the University of Oregon in 1969 and my Ph.D. in Wood Chemistry from the University of Montana in 1975. I completed a Post-Doctoral appointment in Chemistry at Iowa State University in 1975.

9. Following my graduate education at the University of Montana, I joined the Koppers Co. in 1975, where I eventually managed Research and Development functions that spanned all of the company's activities related to wood treatment. During those years, Koppers dominated the wood treatment industry with over 25 treating plants that used oil-borne preservatives such as pentachlorophenol ("Penta" or "PCP") in oil for poles, pilings, and other round stock; creosote for crossties and timbers; water-borne preservatives for lumber and timbers; and fire retardants for lumber and composites. In addition, Koppers manufactured and/or used creosote, Penta solutions, chromated copper arsenate, and fire retardants in bulk quantities, and one division had a number of in-can formulations for the retail market. This work gave me a broad base of knowledge on the wood treating industry, preservatives, fire retardants, and standard and code organizations.

10. I continued as Manager of Research and Development for the Hickson Corporation when it was spun off from Koppers in 1989. In 1992, I started McIntyre

Associates as a private consulting firm, and I have continued in that role to the present. Since then, I have helped develop and commercialize over 20 different preservative or fire-retardant systems using either code evaluation procedures or AWWPA standardization.

11. I am the author or co-author of over 100 technical publications involving treated wood and frequently present at wood preservation conferences. I hold five patents involving treated wood, three of which are in commercial use.

12. I am an active member of the American Wood Protection Association (AWPA) and other organizations that involve treated wood. I have held numerous leadership roles in professional organizations in the forest products and wood preservation chemical industries. I have served on the AWWPA Executive Committee, am a Past Chairman of Subcommittee T-2 on Treatment of Lumber and Timber, Past Chairman of Subcommittee P-7 on Fire Retardants, and Past Chairman of Subcommittee P-9 on Nonbiocidal Wood Protection. I also chaired ASTM Subcommittee E5.14 on External Fire Exposure Tests and have had numerous leadership roles in the ASTM E5 Fire Standards Committee. In 2007, the AWWPA gave me its highest honor, the Award of Merit.

13. I am a member of the American Chemical Society, the American Wood Protection Association, ASTM International, the Canadian Wood Preservation

Association, the Forest Products Society, the International Research Group on Wood Preservation, and the Society of Wood Science and Technology.

14. I have extensive experience with essentially all commonly used preservative formulations in the wood treatment industry, including oil-borne preservatives such as Penta, copper naphthenate, creosote, and newer organic preservatives including DCOI. I have done extensive work with many experimental preservative systems throughout my career.

15. Further, I have direct experience with isothiazolinones that are structural analogues of DCOI and that exhibit similar chemical properties and formulation behavior. During my time at Koppers, the company used a mixture of two isothiazolinones—specifically, methylisothiazolinone (“MIT”) and chloromethylisothiazolinone (“CIT”)—as a moldicide on wood treated with waterborne formulations such as chromated copper arsenate (“CCA”).¹ In the mid-1990s, I carried out an extensive moldicide evaluation program for ISK Biosciences in which DCOI and other isothiazolinones were tested for efficacy in wood preservation applications.

16. A copy of my curriculum vitae is submitted herewith as Exhibit 2013.

¹ A moldicide is a chemical agent designed to kill, inhibit, or prevent the growth of mold and mildew.

17. I have previously provided expert testimony in multiple cases involving wood treatment and preservative issues in both federal and state courts. My testimonial history includes depositions and trial testimony in matters involving utility pole failures, wood treatment, preservative chemistry, and the manufacture and performance of both preservatives and fire retardants. My expertise and work history are documented in my CV. *See* Exhibit 2013.

18. I am being compensated at my customary rate of \$500.00 per hour for my time in connection with this matter. The compensation received from this case is not contingent upon my opinions or performance, the outcome, or any issues involved in or related to the proceeding.

III. MATERIALS CONSIDERED

19. I have reviewed the '716 Patent, the claims of the '716 Patent, the file history of the '716 Patent, the U.S. Provisional Application No. 63/230,817 ("the '817 Provisional Application"), filed August 5, 2021, as well as the PCT Application No. PCT/US2022/074619 ("the '619 PCT Application"), filed August 5, 2022.

20. In forming my opinions, I have considered the materials listed above and any other documents cited in this declaration. I have also relied on my own education, knowledge, and experience in the relevant art.

21. I have also considered the understanding of a person of ordinary skill in the art (“POSA”) around the time of the invention of the Challenged Claims of the ’716 Patent.

IV. MY UNDERSTANDING OF LEGAL PRINCIPLES

22. I understand that Petitioner bears two burdens. First, I understand that, for institution of post-grant review, Petitioner must demonstrate that it is more likely than not that at least one challenged claim is unpatentable.

23. Second, I understand that, once instituted, Petitioner must demonstrate by a preponderance of the evidence that the Challenged Claims are unpatentable. I understand that the preponderance of the evidence standard is one characterized as being more likely than not. Petitioner bears the burden of establishing unpatentability separately for each challenged claim.

24. I further understand that determining whether a patent claim is unpatentable generally requires two steps: first, construing the meaning and scope of the claim terms, and second, comparing the properly construed claims to the prior art or other asserted grounds of unpatentability. I understand that the Petition asserts the Challenged Claims are unpatentable under 35 U.S.C. §§ 102, 103, and 112 based on anticipation, obviousness, lack of written description, lack of enablement, and indefiniteness.

25. I understand that my analysis requires an understanding of the scope of the '716 Patent claims and that the disclosures of the '716 Patent and the prior art are judged from the perspective of a POSA at the time of the '716 Patent's effective filing date. For the purposes of this declaration, I have been instructed to consider the earliest possible priority date for the '716 Patent to be August 5, 2021, and my analysis is based on the perspective of a POSA as of that date.

A. Claim Construction

26. I understand that in a post-grant review, claims of an unexpired patent are to be construed according to the ordinary and customary meaning the claim terms would have had to a POSA at the time of the effective filing date, in the context of the entire patent, including the specification. I further understand that the intrinsic record—comprising the claims, the specification, and the prosecution history—is the primary basis for claim construction, with the specification typically being highly probative of claim meaning. I understand that the prosecution history may also inform the meaning of claim terms. I further understand that extrinsic evidence, such as dictionaries and expert testimony, may be considered as appropriate but is generally less significant than the intrinsic record and cannot be used to contradict it.

27. Unless otherwise indicated, I have applied the plain and ordinary meaning of the claim terms as they would have been understood by a POSA at the time of the effective filing date, in view of the intrinsic evidence.

B. Anticipation

28. I understand that a claim is unpatentable if it is anticipated. I understand that anticipation of a claim requires that every element of a claim is expressly or inherently disclosed in a single prior art reference. I understand that an anticipating reference need not use the exact terms of the claims, but must describe the patented subject matter with sufficient clarity and detail to establish that the claimed subject matter existed in the prior art and that such existence would be recognized by persons of ordinary skill in the field of the purported invention. I also understand that an anticipating reference must enable one of ordinary skill in the art to reduce the purported invention to practice without undue experimentation.

C. Obviousness

29. I understand that a patent claim is unpatentable if the claimed invention would have been obvious to a POSA at the time of the effective filing date. This means that, even if all requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable if a POSA would be motivated to combine two or more analogous prior art references with a reasonable expectation of success.

30. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a POSA at the time of the effective filing date in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness.

31. I also understand that obviousness may be established by combining or modifying the teachings of the prior art. A rationale supporting combination or modification may be explicit or implicit, but if relied upon must have existed before the date of purported invention. I understand that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the knowledge of a POSA.

32. I further understand that whether there is a reasonable expectation of success from combining references in a particular way is also relevant to the analysis. I understand there may be a number of rationales that may support a conclusion of obviousness, including combining familiar elements according to known methods to yield predictable results or a combination was obvious to try.

33. I understand that it is not proper to use hindsight to combine references or elements of references to reconstruct the invention using the claims as a guide. Rather, I understand that one should analyze obviousness from the perspective of a POSA without using hindsight knowledge derived from the patent claims themselves to determine whether the inventions claimed in the patent would have been obvious in view of the prior art and the knowledge and motivations of a POSA, among other things. My analysis of the prior art is made from the perspective of a POSA at the time of the claimed invention's effective filing date and does not rely on hindsight.

34. I understand that objective indicia of non-obviousness may be relevant to the determination of whether a claim is obvious. Such objective indicia can include evidence of commercial success caused by an invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, skepticism or disbelief by those skilled in the art, failure of others, praise of the invention, evidence that an invention achieved a surprising result, or near-simultaneous invention by multiple parties.

35. I understand that for a reference to be used to show that a claim is obvious, the reference must be analogous art to the claimed invention. I understand that a reference is analogous to the claimed invention if the reference is from the same field of endeavor as the claimed invention, even if it addresses a different problem, or if the reference is reasonably pertinent to the problem faced by the

inventor, even if it is not in the same field of endeavor as the claimed invention. I understand that a reference is reasonably pertinent based on the problem faced by the inventor as reflected in the specification.

36. I further understand that the teaching-away doctrine constrains the obviousness analysis. A prior art reference teaches away from a claimed invention when a POSA, upon reading the reference, would be discouraged from following the path set out in the reference or would be led in a direction divergent from the path that was taken by the claimed invention. I understand that when the prior art teaches away from combining certain known elements, the discovery of a successful means of combining them is more likely to be nonobvious. I also understand that teaching away, on its own, is sufficient to sustain a finding of nonobviousness.

37. I further understand that where one reference expressly identifies as problematic the very feature upon which another reference depends, a POSA would be discouraged from looking to both references simultaneously as sources of teachings to combine, even if neither reference individually teaches away from the claimed invention.

D. Written Description

38. I understand that 35 U.S.C. § 112(a) requires that a patent specification contain a written description of the claimed invention sufficient to reasonably convey to a POSA that the inventor had possession of the claimed invention as of

the filing date of the application. I further understand that the written description requirement is evaluated from the perspective of a POSA based on the disclosure of the specification as originally filed, including the specification, claims, and drawings, and that the disclosure need not describe the claimed invention in haec verba so long as a POSA would understand that the inventor possessed the claimed subject matter.

39. I understand that the written description requirement does not require the patentee to disclose information that is “well-known in the art,” because the specification is viewed from the perspective of one of skill in the relevant art.² A POSA reading the specification brings to bear all knowledge that is commonplace in the field, and the patentee need not—and indeed is encouraged not to—reiterate information already well understood by practitioners, as doing so would be duplicative and would unnecessarily lengthen the disclosure without adding to the skilled reader’s understanding. Accordingly, when a specification identifies a general class of materials, a POSA’s preexisting knowledge of the well-known subtypes within that class can provide written-description support for claims directed to those well-known subtypes.

² *Ajinomoto Co., Inc. v. Int’l Trade Comm’n*, 932 F.3d 1342, 1359 (Fed. Cir. 2019).

E. Enablement

40. I also understand that 35 U.S.C. § 112(a) requires that the patent specification enable a POSA to make and use the claimed invention without undue experimentation as of the effective filing date of the claimed invention. I understand that enablement is evaluated from the perspective of a POSA in view of the specification, the knowledge in the art, and the nature of the technology at the relevant time. I further understand that some experimentation may be permissible, provided that such experimentation would not be undue.

41. I understand that whether undue experimentation would be required may depend on several factors, including the nature of the invention, the state of the prior art, the level of ordinary skill in the art, the predictability or unpredictability of the technology, the amount of direction or guidance provided in the specification, the existence of working examples, and the breadth of the claims. I understand that enablement is assessed on a claim-by-claim basis and from the perspective of a POSA at the time of the purported invention.

42. I understand that it is well-established in patent law that a composition claim reciting weight percentage ranges for multiple components is not rendered non-enabled simply because the recited ranges, if their maximum values are selected simultaneously, could theoretically sum to more than 100%. I further understand that subject matter which cannot exist in fact can neither anticipate nor infringe in law.

A POSA reading such claims would understand that the recited ranges define the permissible boundaries for each individual component, and that any actual composition must, of course, have components summing to 100%—thereby excluding from the claim’s scope any theoretical combination that is physically impossible.

F. Indefiniteness

43. I further understand that 35 U.S.C. § 112(b) requires that patent claims particularly point out and distinctly claim the subject matter regarded as the invention. I understand that a claim is indefinite if, when read in light of the specification and prosecution history, the claim fails to inform a POSA, with reasonable certainty, of the scope of the claimed invention. I further understand that absolute precision is not required and that claim language may still satisfy § 112(b) even if a claim is susceptible to more than one interpretation, provided that a POSA would understand the scope of the claim with reasonable certainty in the context of the patent record.

44. I understand that it is well-established in patent law that a composition claim reciting weight percentage ranges for multiple components is not rendered indefinite simply because the recited ranges, if their maximum values are selected simultaneously, could theoretically sum to more than 100%. I further understand that “a rejection based on indefiniteness cannot stand simply because the proportions

actually recited in the claims may be read in theory to include compositions that are impossible in fact to formulate.”³

45. I further understand that where an independent “comprising” claim that recites weight percentages for two components that together could sum to 100%, a dependent claim that further requires an additional component is not rendered indefinite simply because the additional component could theoretically sum the percentages in excess of 100%. Because “comprising” is open-ended and permits additional unrecited components, nothing in such a claim requires the named components in the independent claim to constitute 100% of the composition.

V. BACKGROUND

A. Overview of the ’716 Patent

46. The ’716 Patent discloses a concentrated wood preservative composition comprising DCOI and a retaining additive comprising a wax. DCOI is a preservative compound used to inhibit fungal decay and insect attack in treated wood products such as utility poles, crossarms, railway ties, and similar infrastructure. The retaining additive enhances the leach resistance and retention of DCOI within the treated wood substrate by binding, entrapping, or physically fixing the DCOI within the wood product. The ’716 Patent also discloses a method of

³ *In re Kroekel*, 504 F.2d 1143, 1146 (CCPA 1974); *see also* MPEP § 2173.05(c) (citing *In re Kroekel*, 504 F.2d 1143, 1146 (CCPA 1974)).

treating a wood substrate with the composition diluted in an organic solvent, and a wood product produced therefrom. For context, the concentrated composition is useful for storage and transportation of the wood preservative, while the diluted composition is useful for treatment.

47. The invention disclosed in the '716 Patent addresses a critical need in the wood preservation industry. As I discuss in more detail below, the Stockholm Convention classified Penta as a persistent organic pollutant in 2015, and the sole North American Penta producer ceased manufacturing at the end of 2021. The '716 Patent provides a concentrated DCOI-wax formulation that serves as an effective replacement for Penta-based wood preservative systems, with the wax retaining additive providing excellent leach resistance to maintain DCOI within the treated wood substrate.

B. Prosecution History

48. During prosecution, the Examiner conducted a thorough examination of the claims. The Examiner issued substantive obviousness rejections under 35 U.S.C. § 103 based on three prior art references: U.S. Patent Application Publication No. 2006/0057300 to Cui et al. (“Cui”), Ex. 1016; U.S. Patent Application Publication No. 2006/0240263 to Ashmore (“Ashmore”), Ex. 1017; and U.S. Patent Application Publication No. 2021/0112812 to Arumugam et al., Ex. 1021. *See* Ex. 1004, Part 1, at 86–103. The Examiner also identified allowable subject matter in

dependent claims directed to specific concentration ranges. *See id.* at 103–05. In addition, the Examiner’s prior art search encompassed multiple databases and search strategies. *See id.* at 108–09, 177–94.

49. With respect to Cui, the Examiner recognized that this reference teaches “most of the cumulative limitations” of the independent claims—including DCOI, wax, and the concept of using these components together in wood preservation—but found that Cui fails to teach the specific high-concentration ranges of 40–60% DCOI and the corresponding retaining additive concentrations. Ex. 1004, Part 2 at 164. The Examiner further concluded that “there are no prior art references that provide adequate teachings or apparent reason that would lead the person of ordinary skill to modify Cui as claimed.” *Id.*

C. Challenged Claims

50. It is my understanding that Petitioner challenges all 27 claims of the ’716 Patent. Pet. at 3.

51. Independent Claim 1 recites: “A wood preservative composition comprising: 40% by weight to 60% by weight 4,5-dichloro-2-octylisothiazol-3-one (DCOI) based on a total weight of the composition; and 40% by weight to 60% by weight of a retaining additive comprising a wax based on the total weight of the composition, wherein a weight ratio of the DCOI to the retaining additive is in a range of 1:5 to 5:1.” Ex. 1001, Claim 1.

52. Independent Claim 13 recites: “A wood preservative composition consisting essentially of: 45% by weight to 55% by weight 4,5-dichloro-2-octylisothiazol-3-one (DCOI) based on a total weight of the composition; and 45% by weight to 55% by weight of a retaining additive comprising a first petroleum wax and a second petroleum wax comprising a paraffin wax, wherein the retaining additive comprises a melting point in a range of 75 degrees Celsius to 100 degrees Celsius.” *Id.*, Claim 13.

53. Independent Claim 26 recites: “A wood preservative composition comprising: 40% by weight to 60% by weight 4,5-dichloro-2-octylisothiazol-3-one (DCOI) based on a total weight of the composition; and 40% by weight to 60% by weight of a retaining additive based on the total weight of the composition, wherein the retaining additive comprises a microcrystalline wax, wherein a weight ratio of the DCOI to the retaining additive is in a range of 1:1.5 to 1.5:1.” *Id.*, Claim 26.

54. The following table summarizes the dependent claims:

Claim	Depends From	Additional Limitation
2	Claim 1	Weight ratio of DCOI to retaining additive narrowed to 1:1.5 to 1.5:1
3	Claim 1	Wax comprises an olefin wax, petroleum wax, carnauba wax, polyethylene wax, silicone wax, polypropylene wax, PTFE synthetic wax, or combination thereof
4	Claim 1	Wax melting point in range of 40 °C to 100 °C
5	Claim 1	Wax melting point in range of 75 °C to 100 °C
6	Claim 1	Wax comprises a slack wax
7	Claim 1	Wax comprises a petroleum wax

8	Claim 1	Wax comprises paraffin wax and a microcrystalline wax
9	Claim 1	Composition comprises 45–55% DCOI and 45–55% retaining additive
10	Claim 1	Composition consists essentially of DCOI and retaining additive
11	Claim 1	Composition further comprises an organic solvent
12	Claim 1	A wood product comprising the composition
14	Claim 1	Method of treating a wood substrate by diluting the composition with an organic solvent
15	Claim 14	Organic solvent comprises a hydrocarbon, amine, glycol, ketone, ester, alcohol, halogenated, or biodegradable solvent, or combinations thereof
16	Claim 14	Organic solvent comprises diesel, biodiesel, or a combination thereof
17	Claim 14	Organic solvent flash point of at least 40 °C
18	Claim 14	Organic solvent flash point of at least 60 °C
19	Claim 14	Organic solvent flash point of at least 80 °C
20	Claim 14	Retaining additive has solubility in the organic solvent of at least 0.5%
21	Claim 14	Retaining additive has solubility in the organic solvent of at least 1%
22	Claim 14	Method further comprises contacting wood substrate with diluted composition for a period of time suitable to inhibit fungal decay
23	Claim 14	A wood product produced by the method
24	Claim 23	Wood product retains at least 0.05 pounds of DCOI per cubic foot
25	Claim 23	Wood product comprises a deck, rail, fence, utility pole, pile, railway tie, railroad bridge, cladding, siding, or combination thereof
27	Claim 26	Method of treating a wood substrate by diluting the composition with an organic solvent and contacting the wood substrate with the diluted composition for a period of time suitable to inhibit fungal decay

D. Technical Background Around the Time of the Invention

55. At the time of the '817 Provisional Application filing in August 2021, the wood preservation industry was undergoing a significant transition. The Stockholm Convention classified Penta as a persistent organic pollutant in 2015, and the sole North American Penta producer ceased manufacturing at the end of 2021. This created a critical need for replacement preservative systems, particularly for heavy-duty industrial applications such as utility poles, crossarms, and railway ties.

56. The wood preservative industry faced significant challenges in identifying a suitable replacement for Penta. Specifically, any replacement preservative had to satisfy several critical requirements: it had to possess an environmental profile compatible with contemporary regulatory standards; it had to be supported by long-term performance data demonstrating its capability and suitability for protecting wood; it had to be reasonably cost-effective; it had to be adaptable to existing equipment and treating procedures; and it had to be available in bulk quantities. In 2021 EPA noted that potential alternatives to Penta included oil-borne carriers such as copper naphthenate and DCOI. Ex. 2023 at 12, 27 (also identifying chromated arsenicals, dichromic acid, and creosote). At the time, DCOI was considered a suitable candidate, but there were severe skin corrosion concerns associated with handling DCOI and other isothiazolinones. Ex. 2017 at 4 (noting DCOI is a dermal sensitizer).

57. DCOI was known in the art as a biocide with a wide range of applications. Bulk DCOI (98.5% DCOI) has been approved since at least 2016 for several uses including as a wood preservative. *See* Ex. 2017 at 3–5. The art also referenced a number of other preservatives, such as chlorothalonil, propiconazole, tebuconazole, hexaconazole, and cyproconazole, diniconazole. Ex. 1016 (Cui) at [0019]. Additionally, DCOI is in the isothiazolinone family and there were other members of that family available as a preservative, such as such as methylisothiazolinone (MI), methylchloroisothiazolinone (MCI), benzisothiazolinone (BIT), and octylisothiazolinone (OIT). *See* Ex. 2018 at 2.

58. The prior art, including Cui, taught the use of DCOI in wood preservative compositions at concentrations ranging from 0.1 to 30 weight percent. However, the prior art did not teach or suggest concentrated DCOI-wax compositions at the high concentration ranges claimed in the '716 Patent—40 to 60% DCOI and 40 to 60% retaining additive. This was the specific gap identified by the Examiner in allowing the claims.

59. Prior to the '716 Patent, DCOI was not used in the wood preservative industry at the concentrations recited in the claims—40% to 60% by weight—because the prior art taught DCOI only in dilute treating solutions, typically at concentrations below 30%, and there was no established basis for formulating DCOI at substantially higher concentrations in a binary system with wax. The technical

challenges associated with replacing Penta with DCOI at such elevated concentrations include ensuring compatibility between DCOI and the wax matrix without phase separation, maintaining long-term physical and chemical stability of the resulting solid composition across a range of storage and transportation conditions, and confirming that the concentrated formulation can be reliably re-dissolved in an organic solvent such as diesel without crystallization or loss of biocidal efficacy.

60. A POSA at the time of the '716 Patent's effective filing date would have understood the classification of petroleum waxes and their melting point characteristics. Petroleum waxes are broadly categorized into paraffin waxes and microcrystalline waxes, with paraffin waxes typically having lower melting points (46–68 °C) and microcrystalline waxes typically having higher melting points (60–90 °C or higher).

61. A POSA would have understood that microcrystalline wax is a type of petroleum wax. The '716 Patent specification and the IRM classification of refined petroleum waxes—which was cited by the Examiner during prosecution—confirm this well-known taxonomic relationship. Microcrystalline waxes are derived from petroleum refining and are characterized by their fine crystalline structure and higher molecular weight compared to paraffin waxes. A POSA reading a disclosure of

“petroleum wax” would understand that term to encompass microcrystalline wax, because microcrystalline wax is, by definition, a petroleum wax.

62. Similarly, a POSA would have understood that a blend of a microcrystalline wax and a paraffin wax—both petroleum-derived waxes—when combined in appropriate proportions, can achieve melting points in the range of 75 °C to 100 °C as recited in independent Claim 13 of the ’716 Patent. This is not specialized knowledge; it is basic formulation chemistry understood by anyone working with wax systems in the wood treatment industry.

63. Blended wax formulations have been used in the wood preservation industry since at least the early 1980s. For example, blended petroleum waxes were commonly incorporated into chromated copper arsenate (“CCA”) treatment systems to enhance water repellency, and wax was similarly used with Penta in organic solvent coating formulations for decades. These blends were typically tailored to achieve high degrees of water repellency by melting, dissolving, or emulsifying different waxes—including paraffin and microcrystalline waxes—in various proportions. I am personally named as an inventor on a patent directed to using emulsified petroleum oils for utility pole treatment, and in more recent practice, waxes have been substituted for oils in similar applications. The wood preservation industry has generally adopted the American Petroleum Institute (“API”) standards for classifying and specifying oils and waxes used in these formulations.

VI. LEVEL OF ORDINARY SKILL IN THE ART AND STATE OF THE ART

64. Based on my review of the '716 Patent, its prosecution history, and the prior art of record, it is my opinion that a POSA at the time of the '716 Patent's effective filing date would have had an Associate or Bachelor's degree in chemistry, chemical engineering, wood science, or a related field, with at least three to five years of extensive practical experience in wood preservative formulation, or a graduate degree in one of these fields with at least two years of practical experience. Such a person would have familiarity with wood treatment processes, preservative chemistries, analytical techniques, formulation science, and applicable industry standards (e.g., AWWA standards). Importantly, academic training alone would not be sufficient to qualify as a POSA in this field. The wood preservation industry presents formulation challenges—including compatibility, stability, unpredictability, and processing considerations at commercial scale—that cannot be adequately understood through academic study or laboratory research in isolation. A POSA must possess hands-on industry experience with the practical realities of wood preservative formulation, manufacturing, and application, because it is this real-world experience that equips a skilled practitioner to evaluate the feasibility, scalability, and commercial viability of a proposed formulation.

VII. CLAIM CONSTRUCTION

65. The specification of the '716 Patent explains that “retaining additive comprises a solvent-borne polymeric resin, a wax, or a combination thereof.” Ex. 1001, 5:63–64. I understand Petitioner submits that the term “retaining additive” in Claim 1 should be construed as: “A retaining additive is a solvent-borne polymeric resin, a wax, or a combination thereof.” Pet. at 22 (citing Ex. 1001, 5:63–6:3). I disagree because Petitioner’s construction fails to construe “retaining additive” and merely succeeds in listing possible candidates that may form a retaining additive. As disclosed in the '716 Patent, the retaining additive functions to “bind the DCOI to the wood product, entrap the DCOI within the wood, [and] physically fix the DCOI to the wood product.” Ex. 1001, 5:63–6:3. This limitation thus requires not merely any additive but one that functionally serves as a retention-enhancing agent for DCOI.

66. Independent Claim 1 recites “a wood preservative composition comprising: 40% by weight to 60% by weight [DCOI] . . . and 40% by weight to 60% by weight of a retaining additive comprising a wax . . . wherein a weight ratio of the DCOI to the retaining additive is in a range of 1:5 to 5:1.” Ex. 1001, 24:43–51. A POSA would understand that this claim recites a concentrated formula. Further, a POSA having read the '716 Patent which states that the “wood preservative composition according to the present disclosure can be formulated as a

concentrated composition (e.g., greater than 5% by weight DCOI based on the total weight of the composition) or a diluted composition (e.g., ready to treat formulation, 0.5% by weight to 5% by weight DCOI based on the total weight of the composition)” would understand that composition with less than 5% by weight DCOI would refer to a diluted composition and any composition with greater than 5% by weight DCOI would refer to a concentrated composition. *Id.*, 10:13–19.

67. A POSA would understand “comprising” to be open-ended, permitting additional unrecited components. The weight percentages define concentration boundaries for DCOI and retaining additive relative to the total composition weight, but do not require those two components to be the only components. The weight ratio is an independently defined parameter that constrains the relative proportions of DCOI to retaining additive without reference to any other components.

68. With respect to Claim 13, which recites a retaining additive comprising “a first petroleum wax and a second petroleum wax comprising a paraffin wax,” a POSA would understand this to require a blend of two petroleum-derived waxes, one of which is specifically a paraffin wax. As I explained above, microcrystalline wax is a subset of petroleum wax. A blend of microcrystalline wax and paraffin wax satisfies this limitation because both are petroleum waxes, and the paraffin wax satisfies the “second petroleum wax comprising a paraffin wax” requirement.

69. With respect to Claim 26, which recites that the retaining additive “comprises a microcrystalline wax,” a POSA would understand this term by its plain and ordinary meaning in the art: a refined petroleum wax characterized by its fine crystalline structure, higher molecular weight hydrocarbons, and typical melting points in the range of 60–90 °C or higher. Microcrystalline wax was a well-known component in wood treatment formulations at the time of the ’716 Patent’s effective filing date, and its properties were thoroughly documented in the art.

VIII. TECHNICAL CONTEXT FOR THE PROSECUTION HISTORY AND EXAMINER’S ALLOWANCE

70. A POSA reviewing the prosecution history of the ’716 Patent would understand the Examiner’s allowance as reflecting an identifiable technical distinction between the claimed invention and the prior art—specifically, the absence from the prior art of any teaching or suggestion of concentrated DCOI compositions at 40–60% DCOI with 40–60% wax retaining additive.

71. During prosecution, the Examiner rejected claims under 35 U.S.C. § 103 based primarily on Cui (US 2006/0057300) and Ashmore (US 2007/0175360). Cui teaches DCOI-containing wood preservative compositions with DCOI concentrations ranging from 0.1 to 30 weight percent and hydrophobe (wax) concentrations ranging from 0 to 40 weight percent. Ashmore teaches aqueous wood preservative compositions comprising paraffin wax and a halogenated isothiazolone (DCOI), but is directed to emulsion-based systems for dilute treatment solutions.

72. The Examiner allowed the claims after the Applicant amended them to require the specific concentration ranges of 40–60% DCOI and 40–60% retaining additive (for Claims 43 and 85) and 45–55% for both DCOI and retaining additive (for Claim 67). The Examiner’s stated reason was unambiguous: “the prior art fails to teach all the cumulative limitations of each of the respective independent claims Specifically . . . Cui fails to teach the DCOI concentration of 40% by weight to 60% by weight based on the total weight of the composition And, there are no prior art references that provide adequate teachings or apparent reason that would lead the person of ordinary skill to modify Cui as claimed.” Ex. 1004, Part 2 at 164.

73. A POSA would understand the technical significance of this distinction. The prior art exemplified by Cui was directed to dilute treatment solutions—ready-to-use compositions where preservative concentrations are relatively low because they are already dissolved in an organic solvent for direct application to wood. The ’716 Patent claims a fundamentally different type of composition: a concentrated formulation where DCOI and wax retaining additive together constitute the majority of the composition, without substantial dilution by an organic solvent. This concentrated form is intended to be diluted at the point of use—a different product form that addresses a different stage in the supply chain of wood preservation.

74. The distinction between a dilute treatment solution at 0.1–30% preservative and a concentrated solid or semi-solid composition at 40–60%

preservative is not merely a matter of degree; it reflects fundamentally different formulation challenges. At high concentrations of both DCOI and wax, the formulator must address compatibility, stability, melting behavior, and handling characteristics such as mixing and solubilizing that are simply not relevant to dilute solution chemistry. A POSA would recognize that the claimed concentration ranges represent a meaningful technical advance, not an arbitrary selection from a prior art continuum.

IX. PRIORITY ENTITLEMENT DEFEATS GROUNDS 1–3: WRITTEN DESCRIPTION SUPPORT

75. It is my understanding that Grounds 1–3 depend upon defeating the '716 Patent's claim to priority to the '817 Provisional Application filed August 5, 2021. If the claims are entitled to this priority date, Petitioner's key references—including Archer (filed November 22, 2022), the UP-50 product sales (beginning May 2022), and the EPA Label (dated March 18, 2022)—do not qualify as prior art.

76. I understand that Petitioner's priority argument rests on the contention that the '817 Provisional does not provide written description support for the 40–60% DCOI concentration ranges claimed in the '716 Patent. As I explain below, a POSA reading the '817 Provisional would have understood its disclosure as conveying possession of the claimed subject matter.

A. Written Description Support for the Concentration Ranges

77. The '817 Provisional Application expressly teaches that concentrated compositions “may be formed by mixing the DCOI with a retaining additive (with or without the presence of an organic solvent)” and discloses a weight ratio of DCOI to retaining additive of 1:5 to 5:1. A POSA reading the '817 Provisional would immediately understand that when the organic solvent is absent—as the provisional expressly permits—the only components are DCOI and retaining additive. In such a solvent-free concentrated composition, the weight ratio of 1:5 to 5:1 necessarily corresponds to weight percentages of approximately 16.67% to 83.33% for DCOI, which fully encompasses the claimed 40–60% range.

78. A POSA would not read the '817 Provisional's statement that “[t]he wood preservation composition according to the present disclosure can comprise a concentration of DCOI no greater than 10% by weight based on the total weight of the composition” as limiting the invention to low-concentration formulations. Read in context, this passage is plainly referring to the diluted treating composition—the ready-to-use formulation applied directly to wood—not the concentrated composition. The '817 Provisional expressly distinguishes between these two product forms, defining a “concentrated composition” as one having “greater than 5% by weight DCOI based on the total weight of the composition” and a “diluted composition” as a “ready to treat formulation” having “0.5% by weight to 5% by

weight DCOI based on the total weight of the composition.” The provisional further explains that the concentrated formulation “can be further diluted in an organic solvent to make the final wood preservative treating composition.” A POSA reading the provisional as a whole would understand that the “no greater than 10%” language describes the diluted treating solution—the composition as applied to wood after dilution with an organic solvent—and not the concentrated DCOI-wax composition that is the subject of the ’716 Patent claims. This reading is confirmed by the surrounding disclosure, which discusses the organic solvent’s role in “facilitat[ing] solubilization of the DCOI and/or the retaining additive and/or the penetration of the DCOI into a wood product”—functions relevant only to the diluted treating composition, not to a concentrated solid or semi-solid formulation.

79. The Summary section of the ’817 Provisional further reinforces this two-form structure. The provisional first describes “a wood preservative composition” generally, Ex. 1005, at [0003], and then later describes “a wood preservative composition for application to a wood product,” *id.* at [0007]–[0008]. A POSA reading the ’817 Provisional would have understood this distinction as reflecting two compositional forms: (1) the concentrated form—the DCOI-wax composition that is the subject of the ’716 Patent claims—which serves as an intermediate product intended for storage and transportation, and (2) the diluted form for application to a wood product, which is produced by dissolving the concentrated

composition in an organic solvent such as diesel. This textual distinction in the Summary section confirms that the '817 Provisional's inventors possessed and described both product forms, and that the "no greater than 10%" language that Petitioner relies upon pertains only to the diluted application form—not to the concentrated composition.

80. This is not a matter of cobbling together numbers from unrelated portions of the specification. It is the straightforward mathematical consequence of two explicit teachings in the '817 Provisional: (1) that concentrated compositions can be formed without organic solvent, meaning DCOI and retaining additive are the only components; and (2) that the weight ratio of DCOI to retaining additive is 1:5 to 5:1. A POSA reading these two teachings together would immediately recognize that they necessarily describe compositions within the claimed concentration ranges.

B. A POSA Would Understand That Weight Ratios Can Be Converted to Weight Percentages

81. It is my opinion that a POSA reading the '817 Provisional's disclosed weight ratios would understand those ratios as inherently disclosing commensurate weight percentages for solvent-free compositions. The conversion from weight ratio to weight percentage is elementary arithmetic that any person skilled in formulation chemistry would perform as a matter of routine. This conversion is simplified when the concentrated formulation is a binary system. Ex. 1005, at [0050]. In a binary

system—where the composition is defined by only two components—the weight ratio of Component A to Component B uniquely determines the weight percentage of each component. If A:B = x:y, then wt % A = $x/(x+y) \times 100$ and wt % B = $y/(x+y) \times 100$. Thus, a 1:1 weight ratio for a binary system immediately conveys to a POSA a 50% mixture of Component A and 50% mixture of Component B.

82. The '817 Provisional explicitly lists out the weight ratios that are captured within the recited invention. Ex. 1005, at [0031] (reciting that “a weight ratio of the DCOI to the retaining additive can be in a range of 1:5 to 5:1, such as, for example, 1:4 to 4:1, 1:3 to 3:1, 1:2 to 2:1, 1.5:1 to 1:1.5, or 1.1:1 to 1:1.1.”).

83. These weight ratios correspond to the following percent weights:

Weight Ratio (DCOI : Retaining Additive)	% by Weight DCOI	% by Weight Retaining Additive
1:5 to 5:1	16.67% to 83.33%	83.33% to 16.67%
1:4 to 4:1	20.00% to 80.00%	80.00% to 20.00%
1:3 to 3:1	25.00% to 75.00%	75.00% to 25.00%
1:2 to 2:1	33.33% to 66.67%	66.67% to 33.33%
1.5:1 to 1:1.5	60.00% to 40.00%	40.00% to 60.00%
1.1:1 to 1:1.1	52.38% to 47.62%	47.62% to 52.38%
1:1	50.00%	50.00%

84. Petitioner’s own approach to the Rak reference confirms this understanding. In the Petition, Petitioner and its expert Mr. Morgan convert Rak’s parts-by-weight ranges to weight percentages, stating that “parts by weight can be

converted to weight percent based on the total weight of the concentrate” and concluding that Rak’s preservative concentrations range from “14.3% to 93.5%.” Pet. at 71; Ex. 1002, ¶ 358. Petitioner further calculates that Rak’s Example 6 contains “45% PCP by weight of the solids components ($4.5/10 \times 100 = 45\%$).” Pet. at 72; Ex. 1002, ¶ 359.

85. The arithmetic and methodology used by Mr. Morgan in converting Rak’s parts-by-weight ranges to weight percentages is identical to what a POSA would understand to do in seeing the weight ratios in the ’817 Provisional. The conversion from weight ratio to weight percentage is the same elementary calculation in both contexts.

86. This arithmetic confirms that a POSA would understand weight ratios as disclosing commensurate weight percentages—and therefore that the ’817 Provisional’s weight ratios provide written description support for the claimed concentration ranges.

C. Written Description Support for Microcrystalline Wax and Melting Point Limitations

87. It is my opinion that the ’817 Provisional provides written description support for both the microcrystalline wax limitation and the melting point limitations recited in the ’716 Patent claims because these claims recite features that were well-known in the art at the time the ’817 Provisional was filed.

88. With respect to microcrystalline wax, a POSA reading the '817 Provisional's reference to "petroleum wax" would understand that disclosure as encompassing microcrystalline wax. As I explained above, microcrystalline wax is, by definition, a subset of petroleum wax—this is not specialized or obscure knowledge, but a fundamental classification that any formulation chemist working with wax systems in the wood treatment industry would know. *See* Ex. 2013, 4:38–40 (Viance's U.S. Pat. No. 7,850,771 stating "[e]xemplary petroleum waxes include slack wax or microcrystalline wax."); Ex. 1040 at 14 (explaining that microcrystalline wax and slack wax are types of petroleum waxes); Ex. 1016 (Cui) at [0021] (identifying "slack wax or microcrystalline wax" as exemplary petroleum waxes); Ex. 2014 at [0020]–[0021] (identifying microcrystalline as an exemplary petroleum wax in teaching a wood sealant composition); Ex. 2015 at [0069] (identifying microcrystalline as an exemplary petroleum wax in teaching architectural coating compositions). The '817 Provisional's disclosure of "petroleum wax" therefore provides written description support for the microcrystalline wax limitation recited in Claim 26 of the '716 Patent, as well as Claim 8 (which recites "paraffin wax and a microcrystalline wax"), because a POSA would immediately recognize that microcrystalline wax falls within the genus of petroleum wax disclosed in the provisional.

89. With respect to the melting point limitations, it is my opinion that the '817 Provisional provides written description support for Claims 4, 5, and 13, each of which recites a melting point range for the retaining additive comprising wax. Although the '817 Provisional does not expressly state a numerical melting point range for the wax retaining additive, a POSA at the time the provisional was filed would have known—as a matter of basic, well-established formulation chemistry—that paraffin waxes typically exhibit melting points in the range of 46–68 °C and microcrystalline waxes typically exhibit melting points of 60–90 °C or higher. Ex. 1041 at 4 (disclosing the melting point for a paraffin wax); Ex. 1042 at 4 (disclosing the melting point for a microcrystalline wax); *see also*, Ex. 1016 at [0021] (noting “preferred waxes have a melting point of 30-100 °C”); Ex. 1019 at [0009] (noting “waxes suitable for use . . . preferably have a melting point . . . from 45-160 °C”); Ex. 2013, 4:42-43 (noting “[p]referred waxes have a melting point of 30-100 °C”).

90. A POSA would further understand that by blending a microcrystalline wax and a paraffin wax in appropriate proportions, melting points in the range of 75 °C to 100 °C (as recited in Claims 5 and 13) or 40 °C to 100 °C (as recited in Claim 4) are readily achievable. This is not specialized knowledge requiring explicit disclosure; it is the type of well-known information that a POSA brings to the reading of any patent specification.

91. Additionally, a POSA would have understood how to determine melting points. The ASTM maintains standardized test methods specifically for determining the melting point of petroleum waxes (ASTM D-87, D-3944, and D-127), and the Fuels and Lubricants Handbook, cited by Petitioner, confirms that “[m]elting point is a wax property that is of interest to the consumer and can be an indication of the performance properties of the wax being tested.” Ex. 1040 at 25. In fact, “waxes are often marketed based on melting point data” *Id.* Melting points of waxes are an inherent “general physical propert[y]” that can be found in reference materials or determined.

92. Because the ’817 Provisional discloses petroleum wax—which a POSA understands to encompass both paraffin and microcrystalline waxes with their known melting characteristics—the provisional conveys to a POSA that the inventor possessed retaining additive compositions having melting points within the claimed ranges.

X. DEFICIENCIES IN PETITIONER’S PRIMA FACIE CASE FOR GROUNDS 7–8

93. Having reviewed the Petition and the Declaration of Mr. Morgan (Ex. 1002), it is my opinion that Petitioner’s obviousness grounds for Grounds 7 and 8 fail for multiple independent reasons. As I explain in this section, each of the three primary references—the AWP Paper, Cui, and Rak—is deficient in ways that cannot be cured by combination with the others. Specifically: (1) the AWP Paper

teaches that DCOI performs effectively without any additive, providing no motivation to add wax or create a concentrated binary DCOI-wax system; (2) Cui is directed to a complex multi-component emulsion system that teaches wax as a hydrophobic agent and relies on organic acids—not wax—for preservative retention; (3) Rak is directed to a fundamentally different solvent technology incompatible with oil-borne systems, uses a different preservative (Penta) with entirely different physical properties than DCOI, and expressly teaches that wax alone cannot immobilize a preservative without a polymer; (4) the prior art uniformly teaches wax as a hydrophobic agent rather than as a retaining additive, such that a POSA would not have been motivated to reassign wax to a retention function; (5) Rak merely theorizes a concentrated formulation without any working example, processing parameters, or stability data; and (6) a POSA would lack a reasonable expectation of success in formulating a binary 40–60% DCOI-wax composition given the absence of any prior art guidance and the documented unpredictability of high-concentration DCOI formulations. Moreover, Rak teaches away from both oil-borne systems and using wax without polymers, undermining any motivation to combine Rak with the AWPAPaper and negating any reasonable expectation of success in doing so.

94. My analysis in this section focuses on the three primary references upon which both Grounds 7 and 8 depend: Rak (Ex. 1015), the AWPAPaper (Ex. 1028),

and Cui (Ex. 1016). Ground 7 alleges that Claims 1–16 and 20–27 are obvious over the combination of Rak, the AWPAPaper, and Cui; Ground 8 alleges that Claims 17–19 are obvious over these same three references plus AWPAPaper Standard HSA-18 (Ex. 1030) and HCS 25 Treating Oil SDS (Ex. 1064). Because both Grounds share Rak, the AWPAPaper, and Cui as their foundational references, and because—as I explain below—these three primary references fail to teach or suggest the necessary elements of the ’716 Patent claims, it is not necessary for me to separately address HSA-18 or the HCS 25 SDS. Those two additional references in Ground 8 relate solely to organic solvent flash point limitations in dependent Claims 17–19 and do not cure the fundamental deficiencies in the primary references’ failure to teach concentrated DCOI-wax compositions, the use of wax as a retaining additive, or the claimed concentration ranges. If the primary references fail—as I opine they do—then Grounds 7 and 8 both fail regardless of any supplemental teachings from HSA-18 or the HCS 25 SDS.

A. The AWPAPaper Teaches that Additives are Not Necessary.

95. It is my opinion that a POSA reading the AWPAPaper would conclude that, if one wished to create a concentrated formulation of DCOI for storage and transportation purposes, the simplest and most logical approach would be to use bulk

DCOI (for example, Kathon™ 287T)⁴—that is, pure DCOI without any wax, polymer, or other additive. I base this opinion on the following technical considerations.

96. First, the AWP Paper does not disclose any retaining additive comprising a wax or any other retention-enhancing additive for use with DCOI. Rather, the AWP Paper describes DCOI dissolved directly in organic solvents—principally #2 diesel—for pressure treatment of wood, without any wax or polymer component serving a retention function. Ex. 1028, at 13–14. The AWP Paper provides no weight ratio of DCOI to any additive, retaining or otherwise, because no such additive is taught. A POSA reading the AWP Paper would conclude that simply dissolving bulk DCOI in diesel is sufficient for an efficacious treating formulation, and that no wax or other retaining additive is required.

97. Second, the AWP Paper expressly teaches that “DCOI in #2 diesel will perform similar to [P]enta” with respect to treatment cycle, solution uptakes, penetration gradients, and uptake of the active ingredient into wood. Ex. 1028, at 13. The AWP Paper further concludes that “DCOI in an oil-borne carrier can be expected to perform as an effective wood preservative for use in the industrial treatment of wood poles and sawn cross arms with a service life expected to be equal

⁴ See Ex. 2017 (showing that bulk DCOI has been available since at least 2016).

to, or exceeding, other AWPAs preservatives used at standardized retentions.” *Id.* at 42. Additionally, the AWPAs Paper discloses that DCOI demonstrates “excellent solubility in AWPAs HSA solvents without the need for co-solvents.” *Id.* at 11. Because the AWPAs Paper teaches that DCOI performs well as a simple solution in diesel—without any additive of any kind—a POSA would have no motivation to seek out additional formulation complexity, such as adding a wax retaining additive or creating a concentrated binary DCOI-wax system. There is nothing in the AWPAs Paper that would motivate a POSA to add waxes or polymers to DCOI, because the AWPAs Paper teaches that DCOI treats wood effectively without such additives. In fact, nothing in the AWPAs Paper suggests that use of bulk DCOI without retaining additives performs poorly or that its efficacy should be enhanced.

98. Third, DCOI’s physical properties make a bulk DCOI concentrate, which was already commercially available, inherently feasible as a practical matter. The AWPAs Paper reports that DCOI has a melting point of 41.1–41.7 °C, meaning it is a solid at ambient temperatures but readily melts into a pourable liquid at moderately elevated temperatures. Ex. 1028, at 12. The AWPAs Paper further teaches that “DCOI does not crystallize under standard conditions and remains as an amorphous semi-wax solid in pure form,” and that “even if the loss of the carrier solvent is extreme DCOI will not crystallize out into a form that might not be able

to provide biological control, a phenomenon that has been observed with [P]enta in LPG gas and soft-rot.” *Id.*

99. A POSA reading these teachings would understand that pure DCOI is itself a viable concentrate: it is a stable solid at room temperature that can be stored and shipped without degradation, crystallization, or phase separation, and that can be readily melted and dissolved directly into diesel at the treatment plant to produce a treating solution. In other words, bulk DCOI already satisfies the functional requirements of a concentrate—a high-potency form for shipping and storage that is later diluted for use—without requiring any additive.

100. Fourth, a POSA would have no technical reason, based on the AWWA Paper’s teachings, to add wax or any other component to a DCOI concentrate. Adding wax would introduce additional cost, complexity, and formulation challenges to solve a problem (inadequate treating performance) that the AWWA Paper teaches simply does not exist for DCOI in diesel. A POSA would have been motivated by the AWWA Paper’s teachings to use bulk DCOI with no additives.

101. This conclusion is reinforced by economic and practical considerations that a POSA would have weighed. Bulk DCOI was already commercially available as a concentrate—specifically, Kathon™ 287T, a product containing approximately 98.5% DCOI—that could serve as a practical shipping and storage form without any additives. Ex. 2017. A POSA aware of this commercially available product would

have recognized that adding wax to such a concentrate would increase raw material costs, introduce manufacturing complexity in the form of additional melting, mixing, and cooling steps not required for the bulk DCOI product, and enlarge the logistical footprint by increasing the total mass and volume of material that must be transported per unit of active ingredient delivered. A POSA who read the AWPAPaper’s teachings—which demonstrate that DCOI performs effectively as a wood preservative without any additives—would have had no economic justification for incurring these additional costs and complexities. In the wood preservation industry, cost considerations are a practical reality that skilled formulators weigh when evaluating whether to modify an existing system, and a POSA would not have voluntarily added cost, complexity, and logistical burden to a product that the prior art teaches already works without modification.

102. The AWPAPaper also fails to point a POSA toward concentrating DCOI at the 40–60% levels claimed in the ’716 Patent. Every treatment study described in the AWPAPaper involved DCOI dissolved at concentrations far below the claimed range—for example, the commercial-scale trial at Cox Industries used a treating solution of only 2.5% DCOI in diesel. Ex. 1028, at 13–14. The highest DCOI concentration referenced anywhere in the AWPAPaper is the “23% DCOI Concentrate” (the UP-23 product), which itself is not a binary DCOI-wax system but rather, as I understand it, a multi-component formulation containing polymer-based

inert ingredients and petroleum distillates. *Id.* at 11. A 23% DCOI product with polymers and distillates provides no basis for a POSA to extrapolate to a 40–60% binary DCOI-wax composition without any polymer required. The gap between 23% (in a multi-component system) and 40–60% (in a binary system) is not a matter of routine optimization—it represents a fundamentally different formulation approach that the AWWA Paper neither teaches nor suggests.

103. Moreover, Petitioner points to the AWWA Paper’s statement that DCOI “will perform similarly to Penta” with respect to treatment cycle and penetration gradients as suggesting interchangeability between the two preservatives. Ex. 1028, at 13. However, this teaching relates exclusively to the behavior of dilute treating solutions in diesel—that is, the final ready-to-use formulation applied to wood during the pressure treatment process—and says nothing about the formulation of concentrated compositions. The AWWA Paper’s comparison addresses how DCOI dissolved in diesel at low treatment concentrations penetrates wood in a manner comparable to Penta dissolved in diesel, both of which are oil-borne formulations.

104. The AWWA Paper’s teaching provides no guidance whatsoever on whether DCOI and wax can be combined at 40–60% concentrations in a solvent-free or near-solvent-free concentrated composition, nor does it address the compatibility, stability, or retention characteristics of such a concentrated formulation once diluted and used. A POSA would not have extrapolated from the AWWA Paper’s

observation about dilute treating solution behavior to conclude that a concentrated DCOI-wax composition would be obvious or would function effectively as a wood preservative concentrate.

B. Cui is Directed to a Complex Multi-Component Emulsion System.

105. Cui (US 2006/0057300) is directed to a fundamentally different type of composition than the concentrated binary DCOI-wax formulations claimed in the '716 Patent. Cui discloses a complex, multi-component emulsion system comprising seven or eight distinct components, including an organic preservative (such as DCOI), a wax, an organic acid, an emulsifier, water, and various optional additives. Ex. 1016, [0017]–[0028]. Unlike the single-phase concentrated compositions of the '716 Patent—which consist essentially of DCOI and a wax retaining additive—Cui's formulations are oil-in-water emulsions in which the organic phase (containing the preservative, wax, and organic acid) is dispersed in an aqueous phase stabilized by one or more emulsifiers. *Id.* Emulsion-based systems are inherently more complex than single-phase compositions, requiring careful selection and balancing of emulsifiers, control of particle size, and management of emulsion stability over time. A POSA would have recognized that Cui's emulsion technology involves a fundamentally different formulation approach than the concentrated, solvent-free or near-solvent-free binary compositions claimed in the '716 Patent. Cui also set out to

avoid any use of VOC and thus was directed to a VOC-free organic phase. Ex. 1016 at [0011].

106. Critically, Cui teaches wax as a hydrophobic agent—not as a retaining additive. Cui classifies wax as a component of the organic phase and identifies it as a “strong hydrophobe” whose function is to “provide good water repellency to wood and wood products.” Ex. 1016, [0021]. The retention and fixation functions in Cui’s system are performed by organic acids, not by wax. Cui expressly teaches that the organic acid may serve the following purposes: “(1) increasing preservative solubility in the organic phase, (2) improving the distribution gradient of the active preservative in treated wood, and (3) reducing preservative leaching.” Ex. 1016, [0020]. Reducing preservative leaching—that is, retention—is attributed to the organic acid, not to the wax. *See id.* at [0021] (explaining wax provides “good water repellency”); *id.* at [0036] (explaining that wax-free formulations have “a reduction in water repellency”); *id.* at [0041] (in Example 1 describing the function of “slack wax” as a “water repellant”). A POSA reading Cui would have therefore understood that wax and the retaining agent are distinct components serving distinct functions, and that Cui provides no teaching or suggestion that wax alone could serve as a retaining additive for DCOI.

107. Furthermore, Cui states that the formulation must be wax-free in order to effectively treat Douglas fir which is a very important species for poles. Ex. 1016,

[0036]. In this regard, Cui teaches away from the '716 Patent and an inventor would not look to Cui for guidance on a wax-based product intended for all wood species.

108. It is my opinion that, in addition to the deficiencies described above, a POSA reading both Cui and Rak together would have recognized a fundamental incompatibility between the two references that would discourage any attempt to combine their teachings. Cui is expressly directed to wood preservative compositions formulated in an organic phase “essentially free of volatile organic compounds (VOC).” Ex. 1016, [0016]. Cui identifies that prior art organic solvents “are expensive, difficult to handle due to their flammable or combustible nature, and are environmentally sensitive due to volatile organic compound (VOC) emissions and potential toxicity.” Ex. 1016, [0011]. Cui’s inventive contribution—using waxes, natural oils, organic acids, and emulsifiers as the organic phase—is specifically designed to replace the volatile organic solvents upon which prior art formulations, like Rak, relied. In other words, Cui’s entire principle of operation is the elimination of VOCs from wood preservative formulations.

109. Rak’s preferred solvents, by contrast, are precisely the class of volatile organic compounds that Cui expressly criticizes and seeks to eliminate. Rak identifies as preferred solvents tetrachloromethane (carbon tetrachloride), trichloromethane (chloroform), bromochloromethane, 1,1,1-trichloroethane, bromodichloromethane, trichloroethene (trichloroethylene), and 1,2-

dichloromethane (methylene chloride)—all highly volatile halogenated organic solvents with boiling points below 100 °C. Ex. 1015, 3:9–18. Rak’s formulation mechanism depends entirely upon the volatility of these solvents: they must evaporate rapidly after pressure treatment so that the preservative, wax, and polymer are deposited as solids within the wood microstructure. Ex. 1015, 3:29–36. In my opinion, a POSA reading both Cui and Rak would have recognized that Cui’s fundamental purpose—eliminating volatile organic solvents from wood preservative formulations—is in direct conflict with Rak’s fundamental mechanism, which depends entirely upon those same volatile organic solvents for its operation. Cui identifies as problematic the very class of solvents upon which Rak’s system relies, and a POSA would not have looked to Rak for guidance on formulation when Cui expressly criticizes Rak’s technology as expensive, difficult to handle, and environmentally sensitive. This conflict between the two references would have discouraged a POSA from attempting to draw teachings from both Cui and Rak simultaneously to arrive at a single combined formulation approach.

110. Cui’s disclosure further confirms the absence of prior art support for the claimed concentration ranges. Cui teaches DCOI in concentrations from 0.1 to 30 weight percent—substantially below the claimed 40–60% range—and teaches wax (hydrophobe) concentrations from 0 to 40 weight percent. Ex. 1016. Cui’s disclosure is directed to dilute, ready-to-treat emulsion formulations, not

concentrated compositions. *Id.* A POSA reading Cui would not have been motivated to formulate concentrated binary DCOI-wax compositions at 40–60% DCOI without the guidance provided by the '716 Patent.

C. Rak is Directed to a Fundamentally Different Solvent Technology Than the '716 Patent.

111. Rak (U.S. Patent No. 4,143,010) discloses wood preservative compositions comprising Penta and oxathiins (not DCOI), wax, and synthetic polymer in an organic solvent. While Petitioner asserts that Rak's parts-by-weight ratios can be mathematically converted to weight percentages that overlap with the claimed ranges, this analysis obscures a critical technical distinction: Rak teaches four-composition systems in the form of (1) a preservative, (2) a wax, (3) a polymer, and (4) a solvent carrier. Rak does not teach or suggest a binary concentrated composition of DCOI and wax at the claimed ratios without a third polymeric component or without a solvent. Moreover, Rak's preservative is Penta or oxathiin, not DCOI—a different chemical with different physical and chemical properties, solubility characteristics, and regulatory status.

112. Rak and the '716 Patent are based on incompatible solvent technologies. My review of Rak and the '716 Patent reveals that these references operate by entirely different mechanisms, and a POSA working on oil-borne wood preservative systems would not have looked to Rak for guidance in formulating the compositions claimed in the '716 Patent.

1. Characterization of the Rak Patent

113. Rak is directed to an oil-free wood preservation system that relies on volatile, low-boiling-point solvents for deep penetration into wood. Ex. 1015, 3:9–24, 4:19–23. Rak teaches a deep-penetrating wood treatment and teaches away from surface-blocking wood treatments. Ex. 1015, 6:60–64, 7:22–26 (concluding that oil-borne systems that fail to penetrate are “unacceptable for commercial pressure treatment use”); 8:31 (noting that penetration for oil-borne systems was “relatively superficial” in comparison to preferred volatile solvents); 1:36–38 (listing major disadvantages of oil-borne systems).

114. A deep-penetrating wood treatment is characterized by absorption into the upper layers of the substrate. The active ingredients are carried below the immediate surface and distributed within the wood’s internal structure. The protection arises not from a discrete external film, but from the presence of the active within the structure itself. A POSA would have understood that such a treatment is delivered by a solvent system that transports the active compound into the wood’s cellular network (e.g., vessels and fibers), where it remains after the carrier evaporates. The resulting protection is therefore internal and volumetric—the wood is protected from within, even if the exterior surface is abraded or partially removed.

115. Because the protective mechanism depends on internal distribution, a deep-penetrating treatment must, as a functional matter, be capable of actual

penetration into the wood structure. If the formulation does not penetrate to a sufficient depth—whether due to inadequate solvent properties, excessive viscosity, or poor affinity for the wood substrate—the active material will remain at or near the surface. In that circumstance, the treatment will not provide meaningful internal protection and will instead behave like a surface treatment, leaving the underlying wood vulnerable once the exterior is worn or degraded. In sum, these preservatives must be capable of penetrating the treated wood in order to function.

116. Rak requires a four-component system: (1) an organic preservative, (2) a hydrophobic agent, (3) an amorphous vinylic-type polymer, and (4) a penetrating organic solvent—all four components are necessary for the deep-penetrating system to function. Rak emphasizes that the polymer “must be . . . soluble.” Ex. 1015, 2:51–65.

117. Rak’s preferred solvents are chloroform, methylene chloride, trichloroethylene, and liquefied petroleum gas—all non-oil solvents designed to evaporate rapidly after treatment, leaving solid deposits of the preservative components in the wood. Ex. 1015, 3:9–18. All are VOC.

118. Rak specifies that for deep pressure treatment, the solvents should have low polarity or be nonpolar (with a dielectric constant below 15.0) and should have a low boiling point (below 100 °C) because almost full recovery of solvent is necessary. Ex. 1015, 3:29–36. Rak is designed for deep penetration and prefers

solvents that allow for the ability to penetrate wood in heavy duty scenarios. *Id.* 6:60–64. Rak disfavors oil-based systems that are used for surface blocking treatments and fail to penetrate deep into the wood. *Id.*

119. Rak states that the system is “oil-free” and identifies this as a major advantage for penetration. Ex. 1015, 4:19–23. Rak further teaches away from oil-borne systems by reciting that such systems “have the major disadvantages of wood discolouration [sic], oily unpaintable surfaces, stickiness and dirt retention.” *Id.*, 1:36–38.

120. Rak teaches that the hydrophobe alone cannot adequately immobilize the preservative and the polymer alone cannot bestow adequate water repellency—therefore all components are interdependent. Ex. 1015, 4:5–13.

121. Rak cautions that reduction of penetrability due to polymeric ingredients in significant concentrations would make the preservative system less efficient. Ex. 1015, 4:14–27. Rak expressly warns that “[i]f the hydrophobic agent was omitted, an increase of polymer component would be required.” *Id.* This statement underscores that the polymer is not optional in Rak’s formulation; Rak teaches that the hydrophobic agent (wax) alone is insufficient to achieve the desired retention.ssss

122. Rak’s preservative is present at low concentrations, typically 1–6% (under 10% if soluble), the hydrophobe at 2–4% (and of low molecular weight), and

the polymer at 0.1–1% (not exceeding 30% of total solids). Thus, Rak teaches a system where three components (active ingredient, hydrophobe, and polymer) are present at low concentrations in a fourth component (the solvent), which constitutes the vast majority of the composition. This is a low-concentration system where all components are necessary in what amounts to an expensive carrier. Rak's system is designed to utilize the polymer as a retaining agent that creates a matrix structure to retain the crystalized form of Penta in an effort to address Penta's crystallization and blooming problems. Ex. 1015, 4:1–5. Blooming is the migration of the chemical from deep inside treated wood to the surface, where it cools and crystallizes. Separately, Rak's system utilizes the hydrophobic agent (i.e., wax) to minimize leaching of the Penta out of the wood. *Id.* Finally, Rak's system uses Penta itself to protect the wood from “biological attack and degradation.” *Id.*

123. Rak tested its formulation against the Blunt et al. system in Example 6, which used solvent naphtha (an oil-type solvent), and Rak's data show that the Blunt formulation in naphtha failed to achieve adequate penetration. Ex. 1015, 6:45–7:47. Thus, a POSA reading Rak would understand that oil-type solvents are “unacceptable for commercial pressure treatment use for which the present formulation is primarily designed.” *Id.*, 7:22–25. In other words, a POSA hoping to develop “an alternative oil-borne preservative to” replace Penta would not have looked to Rak because Rak teaches away from oil-based systems. Ex. 1001, 1:45.

124. Rak's Example 7 compared five formulations using low-viscosity chlorinated solvents against one formulation using pole oil (an oil-type solvent). Ex. 1015, 7:48–8:43. The results showed that the oil solution “penetrated into wood at a significantly slower rate,” with the chlorinated systems displaying “27 to 46% higher solution uptake by volume than the oil solution.” *Id.*, 8:24–28. Moreover, “staining of penetrated sections revealed the [Penta] had fully penetrated with the solvent” for the chlorinated formulations, “while for [the oil-based system], penetration was relatively superficial.” *Id.*, 8:28–30. A POSA would understand from this data that Rak teaches away from using oil-based systems because oil hinders penetrability. This is directly relevant because the '716 Patent employs precisely this type of persistent, high-boiling-point hydrocarbon oil (diesel) as its solvent carrier.

125. Rak's Example 8 tested the “Immobilization of Preservative in the Wood Structure” by comparing two samples treated under pressure (120 psi for 7 hours at room temperature): Sample A, treated with 4.5% w/v Penta in methylene chloride, and Sample B, treated with 4.5% w/v Penta plus 4.5% w/v stearic acid and 1.0% w/v polystyrene in methylene chloride. Ex. 1015, 8:50–9:5. The depth of penetration on cross-sectioning in both samples was approximately 0.4 inch—that is, the additives of the invention “did not significantly retard penetration.” *Id.*, 9:1–5. While Rak characterizes this result as positive (because the additives did not impede penetration), the data also demonstrates no improvement in penetration

under pressure treatment. A POSA would recognize that Rak's additives provide no penetration benefit under commercial pressure conditions, undermining any expectation that these additives would improve performance in a high-concentration DCOI-wax system.

126. Rak's Example 9 tested the leaching resistance of oxathiin biocides (D-18 and D-20)—not Penta—with and without Rak's additives (paraffin wax and polystyrene). Ex. 1015, 11:15–12:55. The cumulative leaching data at 140 hours (approximately six days) showed that even with Rak's additives present, the preservative losses remained high: 27% for D-18 with additives and 51% for D-20 with additives. *Id.* (Table 2). Without additives, the losses were even greater: 56% for D-18 and 61% for D-20. *Id.* These high leaching losses—representing the best-case results for Rak's formulation—would preclude commercial use. In my experience, preservative leaching losses of this magnitude are unacceptable for commercial wood treatment products, which must maintain adequate preservative retention throughout the product's service life. A POSA would view these results as evidence that Rak's additive system provides only modest leaching resistance, further diminishing any expectation of success in relying on Rak's teachings.

127. Rak's Example 3 presents microscopic tests of the preservative composition deposited in thin layers from the same three solutions (I, II, and III) described in Example 1. Ex. 1015, 9:37–67. Example 3 demonstrates that after an

accelerated evaporation test (70 hours under vacuum), Penta protected by no additive “has 99% disappeared” and Penta with the hydrophobic agent alone (stearic acid) also showed that “P[enta] crystals have also disappeared from major part of sample.” *Id.*, 9:53–58. Only the sample containing Penta with both stearic acid and 0.7% w/v polystyrene demonstrated “protection of [Penta] crystals which were partially embedded in a transparent layer of polystyrene.” *Id.*, 9:60–65. The “comparison of the photomicrographs showed the important function of the polymer as a necessary component in the preservative composition to protect the preservative (PCP) against loss due to sublimation.” *Id.*, 9:65–10:1 (emphasis added). This confirms that wax alone—without the polymer—is insufficient to retain the preservative in Rak’s system.

128. Rak’s Example 4, a “Soil Block Test,” compared the toxicity of wood treated with Penta alone against wood treated with the composition of the invention (3.5% Penta, 1% stearic acid, and 0.7% polystyrene). Ex. 1015, 9:7–10:1. Rak concedes that “[t]here was little difference in toxicity between [Penta] and the composition of the present invention” and that “[s]tatistical analysis showed no significant difference between [Penta] itself and this particular formulation at the tested retention levels.” *Id.*, 9:14–20. Yet Rak then asserts, without supporting data, that “the present invention would bestow much prolonged effectiveness over [Penta] alone.” *Id.*, 9:20–22. This latter claim is entirely conclusory—Example 4 provides

no long-term data, no leaching followed by re-testing, and no basis for the “prolonged effectiveness” assertion. *Id.* A POSA would recognize that Example 4’s actual data demonstrates no statistically significant efficacy benefit from Rak’s additives, undermining confidence in Rak’s broader claims about the system’s performance.

129. Rak’s Example 5 asserts that “toxicity and PCP retention remain high for prolonged service life,” but there is no data in the example to support this claim. Ex. 1015, 9:33–35. The only quantitative data presented in Example 5 is a contact angle measurement: the contact angle on the treated sample reached 180° after 37 minutes. *Id.*, 9:35–36. Contact angle measures hydrophobicity (water repellency), which depends on the hydrophobic agent (wax), and does not demonstrate preservative retention or biocidal efficacy. A POSA would recognize that Example 5 contains no toxicity data, no retention data, and no long-term performance data—yet Rak makes sweeping claims about “prolonged service life” based solely on a water-repellency measurement. This is precisely the type of unsupported assertion that would give a POSA serious doubt about the reliability of Rak’s disclosure.

130. Rak’s Example 13 tested an oxathiin biocide (DCMO) with and without Rak’s additives (paraffin wax and polystyrene), followed by exposure to the wood-decaying fungus *Lenzites trabea*. Ex. 1015, 13:30–14:20. Critically, the leaching step in Example 13 consisted of only 15 minutes of immersion in still water without

agitation. *Id.*, 14:63–66. By contrast, standard industry leaching protocols—such as AWWPA Standard E11-16 (disclosing the “Standard Method for Accelerated Evaluation of Preservative Leaching”)—require multiple cycles of water exchange over days or weeks, often with agitation, to simulate real-world weathering conditions. Rak’s 15-minute immersion in still water would be expected to remove only loose surface deposits, not meaningfully challenge the system’s ability to retain preservative within the wood microstructure under service conditions. Yet Rak’s Figure 3 labels the results of this test as showing performance “after preservative treatment and severe leaching of wood.” Ex. 1015, Figure 3 caption. This characterization of a 15-minute still-water rinse as “severe leaching” significantly overstates the rigor of the test and, by extension, the performance of Rak’s system. A POA familiar with industry-standard leaching protocols would have immediately recognized the inadequacy of this test and would not rely on Example 13 as evidence that Rak’s system provides commercially acceptable leach resistance.

131. Rak’s Examples 14 and 15 describe outdoor exposure tests of white spruce siding and western red cedar shingles treated by non-pressure brush or dip application using 5% w/v Penta with 3.5% w/v paraffin wax and 1.0% w/v polystyrene in perchloroethylene. Ex. 1015, 14:50–15:18. While Rak reports that after five years the treated boards “retained almost their original appearance” and showed “[n]o signs of any decay,” *id.*, 14:65–15:2, the untreated controls also

showed “[n]o signs of any decay” after five years, *id.*, 15:18. Rak’s polymer component did not provide a meaningful performance advantage over conventional Penta formulations in practical, non-pressure coating applications—further undermining a POSA’s confidence in the polymer’s purported retention benefits and, by extension, any expectation of success in relying on Rak’s system as a basis for a DCOI formulation.

132. Taken together, Rak’s experimental data raises serious questions about the practical viability of the disclosed system. The examples contain unsupported efficacy claims (Examples 4 and 5), use a leaching procedure mislabeled as severe that would only remove surface deposits (Example 13), demonstrate no improvement in penetration under pressure treatment (Example 8), and show high leaching losses even with additives present that would preclude commercial use (Example 9). A POSA reviewing Rak’s disclosure as a whole would not have expected that a high-concentration, two-component formulation of DCOI and wax in diesel—without Rak’s polymer and without Rak’s volatile chlorinated solvents—would adequately penetrate wood or provide long-lasting preservative effectiveness. The absence of reliable data supporting Rak’s efficacy claims would have substantially diminished any expectation of success a POSA might have had in relying on Rak’s teachings as a basis for the compositions claimed in the ’716 Patent.

133. Every working example in Rak uses Penta or oxathiins as the preservative; Rak does not disclose DCOI or provide any working example with DCOI.

134. The chlorinated solvents preferred by Rak (methyl chloroform, carbon tetrachloride, methylene chloride) were largely withdrawn from common commercial use in the 1980s due to ozone depletion concerns and subsequent international and domestic regulation. *See generally* Ex. 2020; 42 U.S.C. §§ 7412 (Hazardous air pollutants), 7671q (Subchapter VI: Stratospheric Ozone Protection). Carbon tetrachloride—one of Rak’s expressly preferred solvents—was phased out of production in the United States under the Clean Air Act Amendments of 1990 as a Class I ozone-depleting substance, with production ceasing by January 1, 1996. 42 U.S.C. § 7671c (Phase-out of production and consumption of class I substances). Methylene chloride, while not subject to the same outright production ban, has been subject to increasingly restrictive occupational exposure limits, extensive OSHA regulation, and EPA risk evaluations that have effectively eliminated its routine industrial use in open systems such as wood treatment. Ex. 2019 (showing the EPA’s risk evaluation for methylene chloride); National Emission Standards for Hazardous Air Pollutants for Area Sources, 72 Fed. Reg. 38,864 (July 16, 2007) (codified at 40

C.F.R. Part 63, Subpart QQQQQQ).⁵ Methyl chloroform is classified as a hazardous air pollutant under the Clean Air Act, is subject to stringent NESHAP requirements, and carries OSHA permissible exposure limits that make its use in large-scale industrial wood treatment operations impracticable. 42 U.S.C. § 7671; Ex. 2021 at 2–3 (detailing OSHA’s exposure limits for methyl chloroform).

135. It is my opinion that a POSA as of August 2021 would have viewed Rak’s formulation philosophy as a technological dead end rather than a viable platform for modification. This conclusion is not based merely on Rak’s age—temporal distance alone does not render a reference irrelevant—but rather on the fact that Rak’s entire system is functionally dependent upon a class of solvents that is no longer commercially available or legally permissible for use in wood treatment operations. Rak’s formulation requires volatile, low-boiling-point chlorinated solvents that rapidly evaporate after pressure treatment, leaving solid deposits of preservative, wax, and polymer within the wood microstructure. Ex. 1015, 3:9–24. Without these solvents, Rak’s mechanism of action cannot operate: the preservative

⁵ The EPA noted that several industry commenters reported that the wood preserving industry had not actually used methylene chloride in the wood treating process since 1992, fifteen years prior to the regulation, and argued there was no need for regulation since methylene chloride is an obsolete solvent in the wood preserving industry.

and additives cannot be transported into the wood and deposited as intended. Rak itself confirms this dependency by specifying that its solvents must have boiling points below 100 °C and must be recoverable after treatment. *Id.*, 3:29–36. The high-boiling-point hydrocarbon solvents used in modern oil-borne wood treatment—diesel, biodiesel, and similar petroleum distillates—are fundamentally incompatible with these requirements, as Rak’s own Examples 6 and 7 demonstrate.

136. During my career in the wood treatment industry, I personally witnessed the transition away from chlorinated solvents in the 1980s and 1990s. When I began my career in 1975, chlorinated solvents were used in certain specialized applications, including the “Dow Process” (methylene chloride high-pressure treatment) referenced in Rak. By the late 1980s, these solvents had been effectively eliminated from commercial wood treatment due to a combination of the Montreal Protocol’s phase-out schedule for ozone-depleting substances, increasingly stringent OSHA workplace exposure standards, and EPA regulations under the Clean Air Act. *See supra* ¶ 134. No commercial wood treating operation in North America, to my knowledge, has used chloroform, carbon tetrachloride, or methylene chloride as a treating solvent at any time in the past three decades. A POSA in August 2021 confronting the problem of formulating a DCOI-based replacement for Penta would not have looked to Rak for all of the reasons detailed above as well as it being a reference whose enabling technology was eliminated from

the industry over thirty years earlier—as a starting point for formulation development.

137. Taken together, Rak’s experimental data raise serious questions about the practical viability of the disclosed system. The examples contain unsupported efficacy claims, use mild leaching procedures mislabeled as severe, demonstrate no improvement in penetration under pressure treatment, and show leaching losses that would preclude commercial use. A POSA reviewing Rak’s disclosure as a whole would have had significant doubts about whether the system performed as described, further reducing any motivation to rely on Rak’s teachings.

2. Technical Comparison of the Two Systems

138. Diesel is a persistent, high-boiling-point hydrocarbon solvent—it is technically incompatible with Rak’s requirement for low-boiling-point solvents (below 100 °C) that can be almost fully recovered after treatment.

139. In the ’716 Patent’s oil-borne system, the solvent remains liquid throughout the treatment process and does not need to evaporate to leave deposits in the wood; penetration is achieved through pressure treatment combined with a persistent solvent that maintains the composition in liquid form during application.

140. This is the opposite of Rak’s mechanism, in which the solvent must evaporate rapidly so that the preservative, hydrophobe, and polymer are deposited as solids within the wood microstructure.

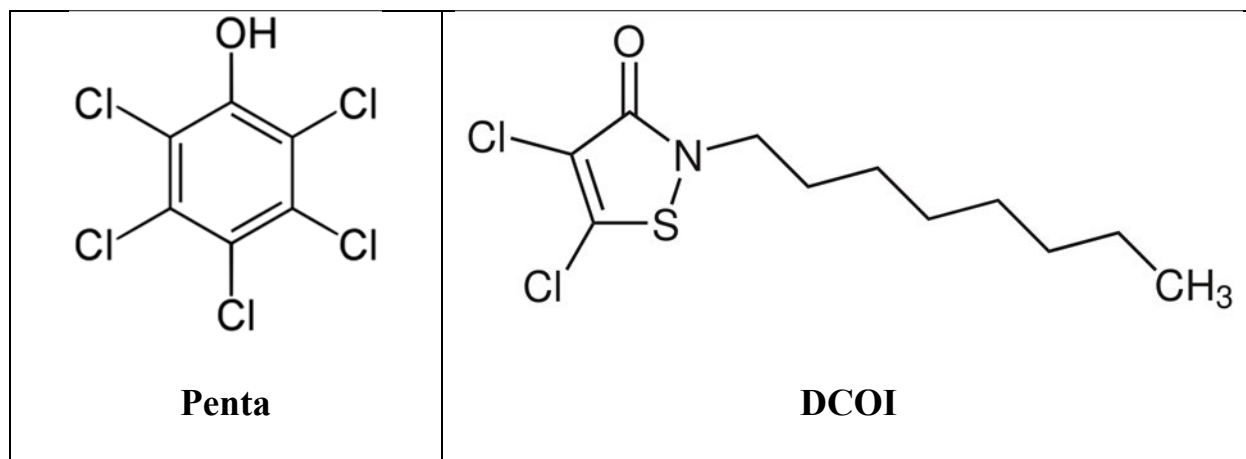
141. The '716 Patent uses wax as the primary retaining additive without requiring a high-molecular-weight vinylic polymer; Rak claims both a hydrophobic agent (e.g., wax) and polymer, and teaches that the polymer is essential for immobilization. Ex. 1015, Claim 1, 4:5–8.

142. In my opinion, substituting a persistent, high-boiling-point hydrocarbon solvent such as diesel for Rak's volatile chlorinated solvents would eliminate the evaporative deposition mechanism on which Rak's entire system depends. The proposed modification would not merely alter a non-essential feature of Rak's system; it would destroy the fundamental operative mechanism by which Rak's system functions—namely, the rapid evaporation of volatile solvents to deposit preservative, wax, and polymer as solids within the wood microstructure. Without this evaporative deposition, the ternary system of preservative, hydrophobic agent, and polymer could not form within the wood, and the system would be inoperable.

143. Rak's penetrability concerns—specifically its warnings about polymeric ingredients impairing penetration—are specific to the physics of volatile-solvent systems where components must be carried into wood via capillary action before the solvent evaporates; these concerns do not apply in the same way to oil-borne systems where the formulation remains liquid during the entire treatment cycle.

3. Penta and DCOI Are Chemically and Physically Distinct Compounds That Behave Differently in Formulation

144. Penta and DCOI are chemically distinct compounds belonging to entirely different chemical classes, and their physical properties diverge in ways that are directly relevant to formulation behavior in a wax matrix. Penta (CAS No. 87-86-5) is a chlorinated phenol—specifically, a benzene ring substituted with five chlorine atoms and one hydroxyl group. DCOI (CAS No. 64359-81-5) is a halogenated isothiazolone—specifically, a five-membered heterocyclic ring with nitrogen and sulfur atoms, two chlorine atoms on the ring, and an eight-carbon alkyl chain.



145. These two compounds share no meaningful structural similarity beyond the fact that both contain chlorine atoms and both function as wood preservatives.

146. The most formulation-critical physical property distinguishing Penta from DCOI is melting point. Penta is a high-melting crystalline solid with a melting point of approximately 191 °C. DCOI, by contrast, has a melting point of about

42 °C. Ex. 1028, p. 12 (reporting melting point of 41.1–41.7 °C). This 150-degree difference in melting point is not a trivial numerical distinction—it fundamentally alters how each compound interacts with a wax matrix. Penta remains a discrete crystalline solid at all temperatures relevant to wood treatment (ambient through ~100 °C), while DCOI melts at barely above room temperature and transitions into a liquid or semi-wax amorphous state under the same conditions.

147. This melting point difference has direct consequences for Rak’s mechanism of action. Rak’s system functions by depositing solid preservative particles within a polymer-and-wax barrier matrix after the volatile solvent evaporates. The system relies on the preservative remaining as a solid within the wood’s cellular structure, immobilized by what Rak describes as a polymer “web, film or matrix structure.” Ex. 1015, 3:60–65. Penta, with its melting point of 191 °C, remains a stable crystalline solid in this matrix under all service conditions. DCOI, however, with its melting point of approximately 42 °C, would melt during hot (>105 °F) weather, during the treatment process itself (which often involves elevated temperatures), or even during transportation and storage. A POSA would recognize that substituting DCOI for Penta in Rak’s system would produce a composition in which the active ingredient is no longer immobilized as discrete solid particles within the polymer matrix. Instead, the DCOI would melt and potentially migrate

through or dissolve into the surrounding wax, thereby undermining Rak's retention mechanism.

148. The crystallization behavior of the two compounds further distinguishes them. Penta readily forms well-defined crystals from organic solvents—the Merck Index reports that Penta forms “crystals from hexane”—and this crystalline character is integral to how Penta deposits and remains fixed in wood after Rak's volatile solvent evaporates. DCOI, by contrast, “does not crystallize under standard conditions and remains as an amorphous semi-wax solid in pure form.” Ex. 1028, p. 12. This non-crystallizing behavior means that DCOI would not form the discrete solid deposits within wood that Rak's system contemplates. A POSA familiar with both compounds would have understood that Rak's retention mechanism—which depends on the preservative remaining as immobilized solid particles within a polymer barrier—is specifically designed for a crystalline preservative like Penta and would not function equivalently with an amorphous, low-melting compound like DCOI. Once again, a POSA would have recognized that Rak's solution is not applicable to DCOI because DCOI does not share Penta's blooming problems. Thus, a POSA would not have been motivated to combine Rak and the AWWA Paper.

149. The solubility profiles of Penta and DCOI also differ in ways relevant to formulation with wax. Penta formulations rely on using high boiling and relatively

expensive solvents such as ketone bottoms to dissolve the Penta. In contrast, DCOI is highly soluble in organic solvents, with reported solubility of 47% by weight in #2 diesel fuel, 68% in xylene, and 40% in acetone. Ex. 1028, p. 11. DCOI is also miscible in most organic solvents. This high solubility means that DCOI would dissolve readily into a molten wax phase rather than remaining as a distinct component within it. In Rak's system, however, the preservative must remain distinct from and immobilized within the hydrophobic agent (wax) and polymer matrix after the solvent evaporates—this is how Rak's "complex network of closed microsegments" functions. Ex. 1015, 4:1–5. A POSA would understand that DCOI's high solubility in organic media, combined with its low melting point, means that at any temperature above approximately 41 °C, DCOI would dissolve into or merge with a wax phase rather than remaining immobilized within it. This fundamentally undermines the retention mechanism that Rak teaches.

150. The mode of biocidal action also differs between these two compounds. Penta functions primarily by disrupting oxidative phosphorylation in target organisms—it uncouples the proton gradient across mitochondrial membranes. DCOI, by contrast, "functions as an effective biocide by reacting with intracellular thiols which participate in the catalytic functions of enzymes" and "is a potent inhibitor of spore germination." Ex. 1028, p. 12. While mode of action does not directly affect formulation chemistry, it is relevant to how a POSA would approach

efficacy predictions: because the two compounds kill organisms by different mechanisms, a POSA could not assume that the concentration ratios optimized for Penta in Rak's system (designed to maintain Penta's effectiveness through controlled release from a solid state) would be appropriate for DCOI, which functions through a different biochemical pathway and exists in a different physical state within the wood.

151. The regulatory profiles of the two compounds reinforce the absence of any straightforward path from one to the other. Penta is classified as a Restricted Use Pesticide, a persistent organic pollutant under the Stockholm Convention, and was ultimately cancelled by the EPA in December 2021. Ex. 1023, pp. 4, 15. DCOI, by contrast, is “not considered by the US EPA to be a Restricted Use Pesticide,” has “an excellent environmental toxicity profile due in part to the fact that it is not persistent in the soil environment,” and produces no harmful dioxins or furans upon combustion of treated wood. Ex. 1028, pp. 11–12. These regulatory differences reflect fundamentally different environmental chemistries—Penta persists and bioaccumulates, while DCOI rapidly degrades in soil. A POSA in 2021 would recognize that these regulatory and environmental distinctions arise from the compounds' entirely different chemical structures and behaviors, further confirming that one cannot simply be substituted for the other in a complex formulation system without extensive reformulation and testing.

152. Based on my experience working with Penta-based formulations for over fifteen years—during which time I personally oversaw research and development of Penta-in-oil treating systems for utility poles—I can state that a POSA with formulation experience would not have viewed a Penta-to-DCOI substitution in Rak’s system as straightforward or predictable. The compounds behave differently in every respect relevant to formulation: Penta is a high-melting crystalline solid that remains fixed in a wax/polymer matrix at service temperatures, while DCOI is a low-melting amorphous compound that would melt into and become indistinguishable from the wax phase. Rak’s entire retention mechanism—polymer barriers immobilizing solid preservative within “closed microsegments”—presupposes a crystalline, high-melting preservative. Replacing Penta with DCOI does not merely swap one preservative for another; it eliminates the physical basis upon which Rak’s immobilization system operates. A POSA would therefore have no reasonable expectation of success that Rak’s system—developed and optimized for a high-melting crystalline preservative in a volatile chlorinated solvent—would function when the preservative is replaced with a low-melting, non-crystallizing compound intended for use in a persistent oil-based solvent system like diesel.

153. Substituting DCOI for Penta in Rak’s system would likely cause serious compatibility issues. The examples in the ’716 Patent confirm this concern: they demonstrate that not all retaining agents are compatible with one another, that certain

solvents provide only mediocre solvency, and that unwanted emulsions can form and interfere with the treating process.

4. A POSA Would Not Look to Rak as a Starting Point for an Oil-Borne DCOI Formulation

154. In my opinion, a POSA working on oil-borne wood preservative systems would have understood Rak's disclosures as directed to a fundamentally different solvent technology—one that is not applicable to formulations designed for use in persistent hydrocarbon solvents such as diesel. A POSA would have further understood that substituting DCOI for Penta in Rak's system is not a straightforward or obvious modification, but rather one that would undermine the very physical and chemical mechanisms upon which Rak's system depends.

155. A skilled formulator working on oil-borne systems would not have looked to Rak for guidance because Rak's teachings are specific to volatile-solvent systems, and Rak's own data demonstrate that oil-type solvents (e.g., the Blunt naphtha formulation, pole oil) failed to achieve adequate penetration in Rak's system.

156. Beyond the solvent incompatibility, a POSA would have recognized that the proposed substitution of DCOI for Penta is not a simple one-for-one swap of interchangeable preservatives. Rak's retention mechanism depends on depositing a high-melting, crystalline preservative as discrete solid particles immobilized within a polymer-and-wax barrier matrix as the volatile solvent evaporates. Penta,

with its melting point of approximately 191 °C and well-defined crystalline structure, is ideally suited to this mechanism. DCOI, by contrast, melts at about 42 °C, does not crystallize under standard conditions, and is highly soluble in organic media. A POSA would understand that replacing Penta with DCOI would eliminate the solid-state immobilization upon which Rak's entire retention mechanism is premised—DCOI would melt into and dissolve within the wax phase rather than remaining as discrete, entrapped particles. In short, Rak's system was designed for a crystalline, high-melting preservative, and substituting an amorphous, low-melting compound like DCOI would not merely change the identity of the active ingredient but would fundamentally defeat the mechanism by which Rak's system retains the preservative within the treated wood.

157. Petitioner's obviousness arguments oversimplify the technical challenges inherent in developing a concentrated DCOI-wax wood preservative composition. Petitioner's own development history—[REDACTED]
[REDACTED] undercuts its position and confirms that the substitution of DCOI for Penta in a concentrated wax-based system was not a simple substitution. The record shows that [REDACTED]
[REDACTED] encountering significant technical obstacles along the way.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] This extended development effort, spanning from at least 2018 through 2021, involved internal evaluations, pilot plant testing at customer facilities, and multiple rounds of assessment before Petitioner even applied for EPA registration in March 2021. If substituting DCOI for Penta in a concentrated wax-based composition were as straightforward as Petitioner now contends, one would

not expect the years of iterative formulation work, the multiple failed or suboptimal formulation generations, and the substantial capital expenditure that Petitioner’s own records document. The protracted path from concept to a viable commercial product is itself strong evidence that the claimed invention would not have been obvious to a POSA.

160. A POSA would also have lacked motivation to attempt this substitution because Rak’s preferred chlorinated solvents were largely withdrawn from commercial use due to environmental regulations; thus, a POSA in August 2021 would have viewed Rak as a technological dead end—not a starting point for modern DCOI formulation development.

161. Even assuming, *arguendo*, that a POSA would have looked to Rak as a starting point, the Petition fails to allege a technically principled reason why a POSA would have selected DCOI—specifically—as the replacement preservative for Penta in Rak’s system. At the time of the ’716 Patent’s effective filing date, a POSA confronted with Penta’s regulatory phase-out would have been aware of numerous biocide alternatives. These include copper naphthenate (“CuN”), oxine copper, chromated arsenicals, creosote, and other organic biocides such as chlorothalonil, propiconazole, tebuconazole, hexaconazole, cyproconazole, and imidacloprid. Within the isothiazolinone family alone—the same chemical class to which DCOI belongs—a POSA would have considered methylisothiazolinone (“MI”),

methylchloroisothiazolinone (“MCI”), benzisothiazolinone (“BIT”), and octylisothiazolinone (“OIT”). Rak itself identifies still other alternatives, including oxathiin derivatives such as carboxanilides that were available on the market. Ex. 1015, 10:52–11:15. The Petition fails to meaningfully engage with any of these alternatives or to explain why a POSA would have singled out DCOI from this broad genus of available biocides for incorporation into Rak’s system. In my opinion, absent use of the ’716 Patent’s claims as a blueprint, this large and diverse genus of wood preservative compounds provided suitable alternatives—individually or in combination—that would have been possible replacements for Penta. The Petition fails to allege a scientific or technically principled basis for a POSA to disclaim these alternatives in favor of DCOI.

162. Significantly, the EPA itself identified CuN—not DCOI—as the “leading alternative to [Penta]” and predicted that CuN was the “most likely” replacement for Penta. Ex. 1023, at 12. The EPA further noted that “DCOI lacks a track record as a preservative for utility poles.” *Id.* at 40. A POSA in August 2021, aware of the EPA’s assessment, would have directed attention toward CuN rather than DCOI as the most obvious candidate to replace Penta in any formulation system. Moreover, DCOI presents severe skin corrosion concerns—DCOI and other isothiazolinones are recognized dermal sensitizers and corrosives—that would have given a POSA working on concentrated formulations particular pause, because

handling a 40–60% DCOI solid block presents substantially greater worker safety challenges than handling a dilute solution. In my experience in the wood preservation industry, worker safety and handling concerns are a practical reality that skilled formulators take seriously when evaluating candidate biocides for new product development. These considerations further militate against the conclusion that a POSA would have selected DCOI over the many available alternatives—particularly CuN, which was not only identified as the leading replacement for Penta but does not present the same skin corrosion hazards at the concentrations used in commercial formulations.

163. For these reasons, a POSA would not have had a reasonable expectation of success in substituting DCOI for Penta in Rak’s system. The chemical and physical differences between these two compounds—melting point, crystallinity, solubility, potency, and mode of action—are not minor variations but rather fundamental distinctions that render Rak’s retention mechanism inoperative when DCOI is used in place of Penta. A POSA would understand that a new formulation approach was required to achieve effective DCOI retention in wood, and the ’716 Patent’s concentrated DCOI-wax composition represents that new approach.

164. Transporting Rak’s wax-and-polymer teachings from the oil-free volatile-solvent context in which they were developed into an oil-based system would not be a straightforward exercise because the mechanism by which Rak’s

additives function—depositing solids after solvent evaporation—does not operate in a system where the solvent persists.

165. It is further my opinion that, even setting aside the solvent incompatibility and the chemical distinctions between Penta and DCOI, a POSA would have recognized that Rak’s formulation system is unsuitable for commercial wood treatment applications. Rak’s system requires expensive chlorinated solvents that are heavily regulated for environmental and occupational health reasons, and it is impracticable to recover these solvents in commercial treating operations at the scale required for industrial wood preservation. Moreover, Rak’s own leaching data—obtained using what the patent characterizes as “severe” conditions, but which are in fact mild by industry standards—demonstrate significant preservative losses that would present environmental concerns for end users and require substantial overtreatment to compensate for leaching. In my assessment, Rak represents an expensive modification to the Penta formulations that were in use during the 1950s through 1970s but were discontinued in the 1980s. A POSA seeking to develop a concentrated DCOI-wax formulation would have had no reason to look to Rak for guidance.

5. A POSA Would Have Had No Motivation to Combine Rak with the AWP Paper.

166. In my opinion, a POSA would not have been motivated to combine Rak with the AWP Paper because the two references point in opposite directions with

respect to solvent technology. As I have explained above, Rak expressly teaches away from oil-borne systems. Rak identifies its oil-free characteristic as “one of the major advantages of these systems,” Ex. 1015, 4:19–23, and directly tested its preferred chlorinated volatile-solvent system against oil-based systems, concluding that oil-based systems are “unacceptable for commercial pressure treatment use for which the present formulation is primarily designed.” Ex. 1015, 7:22–25. Rak’s Examples 6 and 7 demonstrated that oil-type solvents—including solvent naphtha and pole oil—failed to achieve adequate penetration, with penetration in oil described as “only about one third” that of the chlorinated volatile-solvent system and characterized as “relatively superficial.” Ex. 1015, 6:60–64, 8:28–30.

167. The AWWA Paper, by contrast, relies exclusively on an oil-based system. The AWWA Paper teaches DCOI dissolved in #2 diesel—a persistent, high-boiling-point hydrocarbon oil—and concludes that “DCOI in #2 diesel will perform similar to [P]enta” with respect to treatment cycle, solution uptakes, penetration gradients, and uptake of the active ingredient into wood. Ex. 1028, at 13. The AWWA Paper further teaches that “DCOI in an oil-borne carrier can be expected to perform as an effective wood preservative for use in the industrial treatment of wood poles and sawn cross arms with a service life expected to be equal to, or exceeding, other AWWA preservatives used at standardized retentions.” *Id.* at 42. Diesel is precisely

the type of oil-based solvent that Rak condemns as incapable of achieving adequate penetration.

168. A POSA cannot rationally be motivated to combine two references when one expressly condemns the very carrier system on which the other depends. Rak teaches that oil-based systems fail to penetrate wood adequately and are unacceptable for commercial pressure treatment; the AWPAPaper teaches that DCOI performs effectively in the same type of oil-based system that Rak condemns. These two references are fundamentally irreconcilable: a POSA who credits Rak's teaching that oil is unacceptable must reject the AWPAPaper's oil-based approach, and a POSA who credits the AWPAPaper's demonstration that DCOI in diesel is effective would have no reason to turn to Rak's oil-free, volatile-solvent system for formulation guidance.

169. Moreover, even if a POSA were to attempt to extract teachings from both references, there is no coherent basis for doing so. Rak's formulation philosophy is built around the rapid evaporation of volatile chlorinated solvents to deposit solid preservative, wax, and polymer within wood. The AWPAPaper's formulation philosophy is built around a persistent oil-based solvent that remains liquid during treatment and need not evaporate. These are mutually exclusive mechanisms. A POSA would not look to Rak for guidance on how to formulate a

DCOI composition intended for use in diesel—the very outcome the AWWPA Paper describes—because Rak teaches that such oil-based systems do not work.

D. The Prior Art Uniformly Taught Wax as a Hydrophobic Agent, Not as a Retaining Additive

170. It is my opinion that the prior art uniformly taught wax as a hydrophobic agent—that is, a component whose function is to provide water repellency to treated wood—and not as a retaining additive that binds, entraps, or physically fixes a preservative within the wood microstructure. The prior art relies upon polymers and organic acids for retaining additives but never taught that a wax can serve that function. By contrast, the '716 Patent uses wax as a retaining additive for DCOI, with the function of physically entrapping DCOI within the treated wood and enhancing leach resistance. Ex. 1001, 5:65–66, 6:3–9. These are fundamentally different functions, and a POSA would have recognized them as such.

171. In Rak, wax is expressly classified as a “hydrophobic agent” whose function is water repellency. Rak’s abstract states that the composition comprises “(b) a hydrophobic agent” and identifies this component as “fatty acids and their esters, fatty alcohols and paraffin waxes.” Ex. 1015, Abstract; 2:51–65. Rak further explains that the “hydrophobic agent reliably increases the water-repellency *but it cannot adequately immobilize the preservative in the wood microstructure.*” Ex. 1015, 4:5–6 (emphasis added). In Rak’s system, the immobilization and retention function is performed by the amorphous vinylic-type polymer, not by the wax. Rak

teaches that the polymer “forms impermeable barriers (even when in low concentration) effectively limiting sublimation loss and confining the preservative within the cell or closed microsegment.” Ex. 1015, 4:6–12. Rak is explicit that these are distinct, complementary functions assigned to different components: the hydrophobic agent (wax) provides water repellency, while the polymer provides preservative immobilization and retention. The two work together, but each has a different job.

172. Rak further confirms the necessity of the polymer for retention when it warns that “[i]f the hydrophobic agent was omitted, an increase of polymer component would be required.” Ex. 1015, 4:14–16. The logical corollary—which a POSA would immediately recognize—is that the hydrophobic agent (wax) cannot replace the polymer’s retention function. If wax could perform the retention function on its own, there would be no need for the polymer at all. But Rak teaches that the hydrophobic agent “cannot adequately immobilize the preservative.” Ex. 1015, 4:5–6. A POSA reading Rak would understand that wax does not and cannot serve as a retaining additive.

173. In Cui (US 2006/0057300), wax similarly serves a hydrophobic function—providing water repellency—rather than a retention function. Cui identifies wax as a component of the “organic phase” and classifies it as a “strong hydrophobe.” Ex. 1016, [0021]. Cui states that the “wax component of the current

invention includes those that provide good water repellency to wood and wood products.” Ex. 1016, [0021]. The retention and fixation functions in Cui’s system are performed by organic acids, not by wax. Cui expressly teaches that the organic acid may serve the following purposes: “(1) increasing preservative solubility in the organic phase, (2) improving the distribution gradient of the active preservative in treated wood, and (3) reducing preservative leaching.” Ex. 1016, [0020]. Reducing preservative leaching—that is, retention—is attributed to the organic acid, not to the wax. Cui’s working examples confirm this: Example 1, for instance, identifies “slack wax” under the function column as a “water repellent,” while “linseed fatty acid” is listed under the function column as the “acid” that provides the retention-related benefits described at paragraph [0020]. Ex. 1016, [0041].

174. By contrast, in the ’716 Patent, wax serves a fundamentally different function. The ’716 Patent discloses a “retaining additive” that functions to “bind the DCOI to the wood product, entrap the DCOI within the wood, physically fix the DCOI to the wood product, and/or otherwise inhibit movement of the DCOI in the wood product.” Ex. 1001, 5:65–6:3. The claims recite “a retaining additive comprising a wax”—not a hydrophobic agent comprising a wax—and the specification makes clear that it is the wax itself that performs this retention function. The ’716 Patent does not require any polymer for retention. This represents a fundamentally different use of wax from anything taught in the prior art.

175. In my opinion, a POSA would have recognized that wax serves different functions in the prior art (hydrophobicity and water repellency) and in the '716 Patent (preservative retention and fixation within the wood). A POSA would have understood that simply because a component—wax—appears in two different formulation systems does not mean it serves the same purpose in both. Water repellency and preservative retention are distinct physical phenomena. Water repellency involves creating a hydrophobic barrier at the wood surface or cell wall that resists the ingress of liquid water. Preservative retention involves physically entrapping or binding the active ingredient within the wood cellular structure so that it does not migrate out of the wood over time. These are different mechanisms that operate through different physical interactions.

176. Based on my review of the prior art and my experience in the wood preservation industry, it is my opinion that a POSA would not have been motivated to take wax from its taught hydrophobic role in Rak or Cui and reassign it to a retention role. Nothing in the prior art teaches or suggests that wax alone—without a polymer—can adequately retain a preservative within treated wood. To the contrary, the prior art expressly teaches the opposite. Rak states that the hydrophobic agent “cannot adequately immobilize the preservative in the wood microstructure,” Ex. 1015, 4:5–6, and that the polymer is necessary for this function. Cui assigns the leaching-reduction function to organic acids, not to wax. A POSA reading these

references would understand that wax provides water repellency but does not provide preservative retention, and that a separate component—whether a polymer (in Rak) or an organic acid (in Cui)—is required for the retention function.

177. It is further my opinion that a POSA would not have been motivated to eliminate the polymer component from Rak’s system and rely on wax alone for preservative retention. The prior art consistently taught that a polymer was necessary for adequate retention, and Rak expressly warns against relying on the hydrophobic agent alone for immobilization. A POSA reading Cui would have similarly found no suggestion that wax alone could serve as a retaining additive, because Cui relies on organic acids for its fixation and retention functions. The insight that wax alone could serve as an effective retaining additive for DCOI—without any polymer or organic acid—was not taught or suggested by the prior art and would not have been obvious to a POSA.

178. It is further my opinion that a POSA would have recognized an additional, independent reason why a POSA would not have been motivated to add wax to a DCOI-based formulation for the purpose of achieving water repellency: DCOI is itself inherently hydrophobic. DCOI is a halogenated heterocyclic compound bearing a long eight-carbon alkyl chain (n-octyl) and two chlorine substituents, and it exhibits negligible water solubility—reported at approximately 2 mg/L. Ex. 1028, at 11–12. The AWP Paper teaches that DCOI is “sparingly

soluble in water” and is significantly less soluble than Penta. *Id.* at 33. The AWWA Paper also teaches that DCOI in an oil-borne carrier penetrates wood and resists leaching without any wax or hydrophobic additive. *Id.* at 13, 42. The AWWA Paper does not just teach these two facts, it also predicts that the difference in solubility is the reason why DCOI “exhibit[s] significantly lower leaching” than Penta. *Id.* at 33. A POSA would have understood from DCOI’s molecular structure that the compound is strongly hydrophobic in its own right. Because DCOI is itself hydrophobic, a POSA would have had no motivation to add a hydrophobic agent such as wax to a DCOI-based formulation for the purpose of providing water repellency. The function that wax performs in the prior art—namely, imparting hydrophobicity to the treated wood—is already inherent in DCOI’s own chemical nature. This conclusion is independent of, and in addition to, my opinion expressed in paragraphs 165–172 above that the prior art uniformly teaches wax as a hydrophobic agent and that a POSA would not have reassigned wax from its taught hydrophobic role to a retention role. Here, the point is more fundamental: even if a POSA were considering whether to add wax to a DCOI formulation for its known hydrophobic function, a POSA would have recognized that such an addition would be redundant because DCOI itself already provides hydrophobicity to the treated wood substrate.

179. Further, because DCOI exhibits significantly lower leaching than Penta—a consequence of DCOI’s much lower water solubility—a POSA would have understood that the second of Rak’s three identified problems (wetting and leaching of the preservative) does not apply to DCOI. Accordingly, a POSA would have had no motivation to add Rak’s hydrophobic agents (such as wax) to a DCOI-based formulation for the purpose of combating preservative loss through wetting and leaching.

E. Rak Merely Theorizes a Concentrated Solution

180. Petitioner’s treatment of Rak’s Example 6 in the context of Grounds 7 and 8 involves a critical mischaracterization that I must address. This mischaracterization is the only textual support that Petitioner alleges for prior art disclosing an example of a concentrated formulation within the ranges claimed by the ’716 Patent, but it falls short.

181. Petitioner incorrectly characterizes Example 6 of Rak as disclosing a concentrated formulation that is “within the range of DCOI recited in claim 1” of the ’716 Patent. Pet. at 71. It does not. Example 6 is a diluted treating solution—a working solution applied during treatment—not a concentrated formulation. Ex. 1015, 6:45–7:47. Specifically, Example 6 comprises 4.5% w/v Penta, 1% w/v polystyrene polymer, and 4.5% w/v paraffin wax in chloroform as solvent. *Id.* The

chloroform solvent constitutes the vast majority of the composition by weight or volume.

45

EXAMPLE 6

For comparison with the Blunt et al British Pat. No. 1,281,911, two formulations were made up as follows to a constant PCP level. (Percents are on a weight/volume basis). It was necessary to heat the Blunt et al formulation to 55° C. on a water bath to obtain dissolution.

Component	Present	Blunt et al
55 PCP %	4.5	4.5
Polystyrene %	1	4.5 (100% of PCP)
Paraffin wax %	4.5	—
Escorez resin % (Esso)	—	9% (200% of PCP)
Solvent	Chloroform	Solvent Naphtha

Figure 1: Example 6 from Rak Shows a Diluted Penta Composition with 90% Solvent

182. Example 6 explicitly states that the “[p]ercents are on a weight/volume basis.” *Id.* This example is plainly a low-concentration treating formulation, comparable to the dilute treatment solutions described elsewhere in Rak and throughout the prior art. Rak does not contain any working example disclosing a concentrated formulation—that is, a solvent-free or near-solvent-free composition in which the solid components constitute the majority of the total weight. The concentrate concept appears only in a single paragraph of Rak’s specification and in Claim 9, stated in bare parts-by-weight terms without any disclosure of processing conditions, physical form, stability, or performance data. Ex. 1015, 17:20–38.

183. To manufacture the desired percent-by-weight figure, Petitioner impermissibly strips the solvent from Example 6’s diluted formulation, isolates only the solid components (4.5 parts Penta, 4.5 parts paraffin wax, and 1 part polystyrene

polymer), and then recasts those solids—totaling 10 parts—as if they constitute a stand-alone concentrated composition. It is from this stripped-down, solvent-free recalculation that Petitioner derives the figure of 45% Penta by weight of solids ($4.5/10 \times 100 = 45\%$). Pet. at 72; Ex. 1002, ¶ 359. This two-step conversion—first, stripping the solvent from a diluted solution and then, second, recasting the remaining solids as a concentrated composition—is not a legitimate reading of Rak’s disclosure. Rak’s Example 6 does not teach or exemplify a concentrated, solvent-free formulation; it teaches a dilute treating solution in which all components—preservative, wax, polymer, and solvent—interact together in the presence of a large excess of chloroform.

184. A POSA would not have read Example 6 the way Petitioner proposes. A POSA would have understood that the solid components in Example 6 are not taught in a concentrated, solvent-free formulation. The chloroform solvent present in Example 6 is not merely a carrier that can be disregarded without consequence; it may be a necessary component that enables the solid components to interact properly. Removing the solvent from Example 6 and assuming the solid components would function identically as a solvent-free composition could introduce compatibility issues, phase separation, gelling, stability problems, or other adverse effects that Rak never addresses in the context of a concentrated form. Indeed, Rak provides no data whatsoever on whether Penta, paraffin wax, and polystyrene would

form a stable, homogeneous solid when combined at approximately 45%, 45%, and 10% by weight without any solvent.

185. Disregarding the solvent used in Example 6 fundamentally misreads what Rak actually discloses. While Rak theorizes in a single paragraph that its formulation can be prepared as a “masterbatch or concentrate (without the organic solvent) or as a paste with small amounts of the organic solvent,” this bare statement is not accompanied by any working example, any processing parameters, any physical characterization, or any performance data for a concentrated form. Ex. 1015, 17:20–24. Every working example in Rak—including Example 6—uses Penta or oxathiins dissolved at low concentrations (typically 1–6% w/v) in a volatile organic solvent that constitutes approximately 90% or more of the total composition. None of Rak’s examples prepare, characterize, or test a solvent-free concentrate. It is therefore improper to read Example 6—a dilute treating solution—as if it were an actual disclosure of a concentrated formulation from which the solvent could be removed without affecting the interactions between the solid components.

F. A POSA Would Lack a Reasonable Expectation of Success

186. It is my opinion that a POSA as of August 2021 would not have had a reasonable expectation of success in formulating a concentrated binary composition of 40–60% DCOI and 40–60% wax without the guidance provided by the ’716 Patent. I base this opinion on the following technical considerations.

187. A POSA would have had significant doubt about whether a binary composition of 40–60% DCOI and 40–60% wax could form a physically stable solid. DCOI is an amorphous, semi-waxy compound with a melting point of only 41.1–41.7 °C. Ex. 1028, at 12. It does not crystallize under standard conditions and remains as an amorphous semi-wax solid in pure form. *Id.* When DCOI is melted and combined with a molten wax at roughly equal proportions—each component constituting 40–60% of the total mass—there is no prior art basis to predict whether the resulting mixture would solidify into a uniform, mechanically coherent solid block or whether the components would phase-separate upon cooling. DCOI’s high solubility in organic media, including wax-like hydrocarbon matrices, means that it does not behave as a discrete crystalline phase that can be mechanically entrapped; instead, it merges with the surrounding wax. A POSA would have recognized the risk that, upon cooling, a 50/50 mixture of DCOI and wax could exhibit phase separation, with DCOI migrating to the surface or pooling within the solid block, creating an inhomogeneous product with unpredictable biocidal delivery characteristics. A POSA would also have been uncertain about whether such a composition would maintain its physical integrity over time—whether the DCOI would leach from or bloom to the surface of the wax matrix during storage, degrading both the physical form and the biocidal concentration profile of the product.

188. The formulation of a concentrated binary DCOI-wax composition at 40–60% concentrations raises specific technical challenges that a POSA would not have been able to resolve through routine optimization based on the prior art.

189. First, miscibility and compatibility: DCOI and wax are both hydrophobic materials, but they are chemically distinct—DCOI is a halogenated heterocyclic compound with a five-membered ring containing nitrogen, sulfur, and two chlorine atoms, while waxes are long-chain hydrocarbon mixtures. At low concentrations of either component in a third solvent (as in Cui’s dilute treating solutions or Rak’s volatile-solvent systems), compatibility is largely irrelevant because the solvent mediates the interaction. But in a binary system at 40–60% concentrations with no solvent, the two components must be directly compatible in each other’s presence—and there was no prior art data establishing that DCOI and wax could form a stable, homogeneous blend at these ratios. A POSA would have been uncertain whether, at such high concentrations, DCOI would remain uniformly distributed within the wax matrix or whether the two components would separate into distinct phases upon solidification.

190. Second, storage stability: A POSA would have been concerned about the long-term storage stability of a binary DCOI-wax solid. DCOI has a melting point of approximately 42 °C, and the wax retaining additives disclosed in the ’716 Patent have melting points ranging from approximately 46 °C to 90 °C or higher. In

warm-climate storage or summer transportation conditions, where ambient temperatures can approach or exceed 40 °C, a POSA would have expected that the DCOI component could soften or partially melt within the solid wax matrix, potentially causing the composition to deform, slump, or lose its solid form. Over extended storage periods—weeks or months in a warehouse—a POSA would have had no basis to predict whether a binary DCOI-wax block would maintain dimensional stability, or whether cyclic temperature fluctuations would cause progressive degradation of the block’s structural integrity through repeated softening and re-solidification of the DCOI.

191. Third, thermal behavior during melt-and-mix processing: [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] A POSA would have been uncertain about the thermal compatibility of DCOI and wax during this process. DCOI has reported thermal stability under accelerated storage conditions—two weeks at 54 °C resulted in only a 0.3% loss of active ingredient. Ex. 1028, at 12. However, the temperatures required to melt higher-melting-point waxes such as microcrystalline wax (melting point of approximately 79–90 °C) significantly exceed these accelerated storage temperatures, and a POSA would have been concerned about whether extended exposure to temperatures of 80–100 °C during the melt-and-mix process could

degrade the DCOI or trigger undesirable chemical reactions between DCOI and the wax. The prior art contains no data addressing DCOI's stability in direct contact with molten wax at elevated temperatures for the duration of a mixing process.

192. A commercially viable concentrate must survive its entire lifecycle: it must be manufactured (melted and mixed), solidified into a form suitable for packaging, transported to treatment facilities (potentially in warm climates), stored for weeks or months, re-melted at the treatment plant, and dissolved into diesel to form a treating solution—all without degradation of the physical form or loss of biocidal efficacy. A POSA would have had no basis in the prior art to predict that a binary DCOI-wax composition could survive all of these steps. The prior art contains no data on the solubility of solidified DCOI-wax blocks in diesel, the rate of dissolution, whether the re-dissolved composition would deliver DCOI at the same efficacy as a freshly prepared solution, or whether repeated heating and cooling cycles during the product lifecycle would alter the composition's physical or chemical properties.

193. As of August 2021, there was no working example in any prior art reference of a concentrated binary composition consisting of 40–60% DCOI and 40–60% wax. Rak discloses four-component systems (preservative, wax, polymer, and solvent) using Penta—not DCOI—as the preservative. Cui discloses DCOI at concentrations of 0.1–30% in multi-component formulations containing wax,

organic acids, and solvents. The AWPB Paper describes DCOI dissolved in diesel at treating concentrations of approximately 2.5%, without any wax or other retaining additive. Ex. 1028, at 13–14. The highest DCOI concentration referenced in the AWPB Paper is the UP-23 product at 23% DCOI, which is not a binary DCOI-wax system but rather a multi-component formulation containing polymer-based inert ingredients and petroleum distillates. *Id.* at 11. None of these references, individually or in combination, provides a working example that would have given a POSA confidence that a binary 40–60% DCOI-wax composition would be stable, functional, and commercially viable. The absence of any such working example would have substantially diminished a POSA’s expectation of success in pursuing the claimed compositions.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED]

[REDACTED] These documented failures demonstrate that the path to a stable concentrated DCOI formulation was not straightforward or predictable, even for a party with substantial resources and direct commercial motivation. A POSA working from the prior art alone—without the benefit of Petitioner’s trial-and-error experience—would have had even less basis for confidence.

XI. GROUND 9: THE ALLEGED “MATHEMATICAL IMPOSSIBILITY”

197. Petitioner alleges that Claims 1, 3–12, and 14–25 are not enabled, lack written description, and are indefinite because it is “mathematically impossible” to satisfy the full scope of the recited weight ratios and weight percent concentrations. This argument fails for reasons that a POSA would have readily understood.

198. Petitioner’s argument rests on the false premise that Claim 1 requires the DCOI and retaining additive to account for 100% of the composition. It does not. Claim 1 uses the transitional phrase “comprising,” which is well understood to be open-ended and to permit the inclusion of additional unrecited components. The claim recites “40% by weight to 60% by weight” of DCOI and “40% by weight to 60% by weight” of retaining additive, each based on the total weight of the composition. Nothing in this language requires the two components to sum to 100%.

199. Claim 11—which recites that the composition “further comprises an organic solvent”—can be satisfied by a composition of 40% DCOI, 40% retaining additive, and 20% organic solvent; this formulation satisfies every limitation of Claims 1 and 11: the DCOI is within the 40–60% range, the retaining additive is within the 40–60% range, the weight ratio of DCOI to retaining additive is 1:1 (within the 1:5 to 5:1 range), and the composition further comprises an organic solvent.

200. A POSA would have immediately recognized that the weight ratio limitation—“wherein a weight ratio of the DCOI to the retaining additive is in a range of 1:5 to 5:1”—is defined solely between DCOI and the retaining additive. This ratio remains constant regardless of dilution with an organic solvent. Adding a solvent does not disturb the weight ratio; it simply reduces the percentage of each component relative to the new total weight. This is a basic principle of formulation chemistry that any POSA would understand.

201. Petitioner’s “mathematical impossibility” argument is further undermined by the fact that Petitioner itself employed the identical claim convention in its own contemporaneous patent application, the Archer PCT Application (WO 2023/096905). Claim 10 of Archer recites specific weight percentage ranges for a preservative, wax, and organic solvent that sum to 144.5% at their upper bounds—far exceeding 100%. If Petitioner’s theory of indefiniteness were correct, its own

application would be equally—indeed more—defective. Regardless, a POSA would have understood that this is a universally accepted claim drafting practice in the chemical arts.

XII. CONCLUSION

202. Based on my review of the record and my expertise in wood preservation chemistry, it is my opinion that:

- a. The '716 Patent claims are entitled to the priority date of the '817 Provisional Application because the '817 Provisional Application provides adequate written description and enablement support for the claimed concentration ranges;
- b. The Examiner's allowance was technically justified and reflected identifiable technical distinctions between the claims and the prior art;
- c. Petitioner's prior art grounds do not establish that it is more likely than not that any claim is unpatentable, because the asserted references—individually and in combination—do not teach or suggest the claimed concentrated DCOI-wax compositions at 40–60% by weight;
- d. Petitioner's invalidity challenges in Ground 9 based on alleged “mathematical impossibility” fail because they rest on a misunderstanding of open-ended claim language, and basic formulation chemistry; and

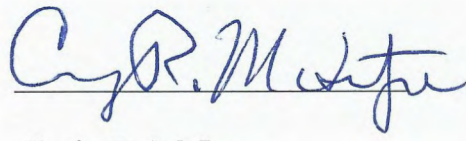
e. Petitioner's expert's opinions are unreliable due to technical and methodological deficiencies identified above.

203. In signing this declaration, I recognize that this declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If called for cross-examination, I will appear for cross examination within the United States during the allotted period.

204. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: June 22, 2026

By:

A handwritten signature in blue ink, reading "Craig R. McIntyre", written over a horizontal line.

Craig R. McIntyre