United States Court of Appeals for the Federal Circuit

00-1441

THE DOW CHEMICAL COMPANY,

Plaintiff-Appellant,

v.

SUMITOMO CHEMICAL COMPANY, LTD.
and SUMITOMO CHEMICAL AMERICA, INC.,

Defendants-Appellees.

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Appealed from: United States District Court for the Eastern District of Michigan

Judge Victoria A. Roberts

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DECIDED: July 25, 2001

Before CLEVENGER, RADER, and GAJARSA, Circuit Judges.

GAJARSA, Circuit Judge.

This is a patent infringement action. The Dow Chemical Company ("Dow") is the assignee of United States Patent No. 4,499,255 ("the '255 patent"), which is directed to a process for making high-purity epoxy resins. In 1996, Dow brought this patent infringement action against Sumitomo Chemical Company, Ltd. and Sumitomo Chemical America, Inc. (collectively "Sumitomo"), alleging that certain processes used by Sumitomo infringe the '255 patent. On June 20, 2000, the United States District Court for the Eastern District of Michigan ("district court") determined that certain limitations required by claim 1 of the '255 patent are not present in Sumitomo's processes either literally or under the doctrine of equivalents, and granted Sumitomo's motion for summary judgment of noninfringement. Dow Chem. Co. v. Sumitomo Chem. Co., No. 96-10330, slip. op. at 7-8, 25 (E.D. Mich. June 20, 2000). Dow appeals that judgment.

For the reasons discussed below, we vacate and remand for further proceedings consistent with this opinion.

I. BACKGROUND

A. Introduction

The '255 patent is directed to an improvement of the process for the preparation of glycidyl ethers, or certain types of "epoxy resins." The preparation of epoxy resins was previously well known in the art. The prior method consisted of preparing glycidyl derivatives of compounds having at least one aromatic hydroxyl group or aromatic amine group per molecule by reacting such compounds with an excess of epihalohydrin ("epi") in the presence of an alkali metal hydroxide, and subsequently recovering the glycidyl derivatives. This process is commonly referred to as an epoxidation reaction. The invention disclosed by the '255 patent is directed to an improvement of this well known method of preparing epoxy resins. The improvement as claimed by the '255 patent consists of certain process conditions that must be present during part of the epoxidation reaction process.

Epoxy resins are often used in electrical applications, including the encapsulation of computer semiconductor chips. One advantage of epoxy resins produced using the claimed process conditions is that they contain lower levels of hydrolyzable halide. Residual halides and other contaminants produced during the epoxidation process are sometimes responsible for computer chip failure. Thus, epoxy resins containing lower levels of hydrolyzable halide are more suitable for encapsulating semiconductor chips, and for use with other electrical applications. At issue in this appeal is the construction of the improvement process conditions as disclosed in claim 1 of the '255 patent.

B. The '255 Patent Claims

Claim 1 of the '255 patent is the only independent claim at issue on appeal. This claim is written in Jepson format, meaning that the claim first describes the scope of the prior art and then claims an improvement over the prior art. The claim reads as follows:

> In a method for preparing glycidyl derivatives of compounds having at least one aromatic hydroxyl group or aromatic amine group per molecule by reacting at least one compound having at least one aromatic hydroxyl group or aromatic amine group per molecule with an excess of at least one epihalohydrin in the presence of an alkali metal hydroxide and subsequently recovering the glycidyl derivative product; the improvement which comprises
>
> (1) conducting the reaction in the presence of an organic solvent which codistills with water and said epihalohydrin at a boiling point below the boiling point of the lowest boiling compound among the components in the reaction mixture;
> (2) conducting the reaction under a reduced pressure sufficient to provide a distillate with a boiling point of from about 45° C. to about 80° C.;
> (3) employing said alkali metal hydroxide as an aqueous solution and adding said aqueous alkali metal hydroxide in a continuous or intermittent manner over a period of from about 0.5 to about 10 hours;
> (4) continuously removing water by means of codistillation at a rate such that the water content in the reaction mixture is less than about 6 percent by weight;
> (5) separating the water from the codistillate and returning the solvent and epihalohydrin to the reaction mixture.

'255 patent, col. 11, ll. 8-26 (emphases added).

C. The Accused Sumitomo Process

Dow asserts that two processes used by Sumitomo infringe claim 1 of the '255 patent. Since 1983, Sumitomo has used two different processes to produce certain high-purity epoxy resins. The two Sumitomo processes are referred to as the "Old DOX" and the "New DOX" processes. Sumitomo used the Old DOX process from 1983 until 1996, and has used the New DOX process since 1996. Both the Old and New DOX processes conduct the well known epoxidation reaction under certain process conditions. Both

processes react orthocresol novolac ("novolac") with epichlorohydrin in the presence of the solvent dioxane.[1] Both the Old and New DOX processes are conducted in two stages.

In the New DOX process, the first stage commences with the addition of potassium hydroxide ("KOH") for one hour. The first hour is conducted without distillation, at atmospheric pressure, and without the removal of water. After the first hour, the first stage of the New DOX process is continued for three hours without the addition of KOH. During this three-hour period, water is removed by codistillation, pressure is maintained at 60 Torr, and the water content is maintained at 0.8 to 1.0 percent by weight.[2] Throughout the entire first stage of the New DOX process, the reaction temperature is maintained at 39° ± 1°C. By the end of the first stage of the New DOX process, the epoxidation reaction is approximately sixty percent complete.

During the second epoxidation stage of the New DOX process, aqueous sodium hydroxide ("NaOH") is added to the reaction mixture for three hours.[3] Throughout the second stage of the New DOX process, the reaction temperature is maintained at 62.5° ± 1°C, and the reaction pressure is maintained at 150 Torr. During this three-hour period, the mixture of water, dioxane, and epichlorohydrin is codistilled such that the water content is maintained at 0.8 to 1.0 percent by weight.

In the Old DOX process, the first stage commences with the codistillation of water, dioxane, and epi upon the initial addition of aqueous KOH. The first hour is conducted with

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[1] Novolac is a "compound having at least one aromatic hydroxyl group" as required by claim 1. Epichlorohydrin is an epihalohydrin ("epi"), as required by claim 1. Dioxane is an organic solvent used during the codistillation process.

[2] The phrase "codistill" is used in the '255 patent to describe the distillation of a mixture of organic solvent, water, and epi (the "codistillate"). Distillation is a separation process in which a liquid is converted to a vapor and the vapor then condensed to a liquid. The latter is referred to as the distillate, while the liquid material being vaporized is the charge or distilland. Distillation is thus a combination of evaporation, or vaporization, and condensation. Hawley's Condensed Chemical Dictionary 418 (13th ed. 1997).

the addition of KOH and simultaneous codistillation. After the first hour, the first stage of the Old DOX process continues for three hours without the addition of KOH. During this three-hour period, pressure is maintained at 60 Torr, and the water content is maintained at 0.8 to 1.0 percent by weight. Throughout the entire first stage of the Old DOX process, the reaction temperature is maintained at 39° ± 1°C. By the end of the first stage of the Old DOX process, the epoxidation reaction is approximately fifty-five percent complete. The second stage of the Old DOX process is identical to that of the New DOX process, except that the addition of NaOH is performed over a three and one-half hour period instead of a three-hour period.

D. Procedural Background

On January 21, 2000, the district court issued its claim construction order in which it construed a number of disputed terms used in claim 1 of the '255 patent. Dow Chem. Co. v. Sumitomo Chem. Co., No. 96-10330, slip. op. at 34, 44 (E.D. Mich. Jan. 21, 2000). Specifically, the district court construed the phrases "boiling point" as used in clause 1 and the terms "continuous" and "continuously" as used in clauses 3 and 4. Id. Dow subsequently asked the district court to clarify its construction of "boiling point" and "continuous/continuously." On April 19, 2000, the district court issued a supplemental claim construction order clarifying its construction of these phrases. Dow Chem. Co. v. Sumitomo Chem. Co., No. 96-10330, slip. op. at 13, 20 (E.D. Mich. Apr. 19, 2000).

The district court initially construed "boiling point" as used in clause 1 of claim 1 to mean that:

> Codistillation must occur at a boiling point of the reaction mixture which is below the boiling point of any components of the reaction mixture, at the reaction pressure.

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[3] Both NaOH as used in the second step, and KOH as used in the first step, are "alkali metal hydroxide[s]" as required by claim 1 of the '255 patent.

Dow, No. 96-10330, slip. op. at 34 (Jan. 21, 2000). In construing this limitation, the district court rejected Dow's contention that clause 1 simply requires that the codistillate "boil off" before any of the components of the reaction mixture. In the supplemental claim construction order, the district court further construed the limitation to require that "the boiling point temperature [of the codistillate be] measured in the reaction mixture" and not in the vapor phase.[4] Dow, No. 96-10330, slip. op. at 13 (Apr. 19, 2000).

The district court construed the terms "continuous" and "continuously" as used in clauses 3 and 4 of claim 1 to require that "codistillation be continuously conducted during the addition of aqueous caustic." Dow, No. 96-10330, slip. op. at 44 (Jan. 21, 2000). In the supplemental claim construction order, the district court further clarified that the limitation requires "distillation to take place throughout the duration of the addition of caustic," or in other words that distillation must begin simultaneously with the addition of the "caustic" alkali metal hydroxide. Dow, No. 96-10330, slip. op. at 20 (Apr. 19, 2000).

On June 20, 2000, the district court granted summary judgment of noninfringement for Sumitomo. Dow, No. 96-10330, slip. op. at 8, 25 (June 20, 2000). The district court ruled that the Sumitomo processes did not literally infringe for three reasons. First, the district court ruled that, in the New DOX process, water is not removed "throughout the duration of the addition of caustic" as required by its construction of the term "continuously" in clause 4. Second, the district court noted that the reaction mixture temperature of the first stage of the Old and New DOX processes is maintained at 39°C ± 1°C. Thus, the district court reasoned that both Sumitomo processes do not meet the limitation contained

[4] The "reaction temperature" or temperature of the "reaction mixture" is determined by measuring the temperature of the liquid in the reaction pot. On the other hand, temperature measured in the vapor phase is determined by suspending a

in clause 2 that the boiling point be between 45°C and 80°C. Third, the district court held that both the Old and New DOX processes do not meet the limitation contained in clause 1 because "the boiling point of the reaction mixture is not below the boiling point of each component of the reaction mixture." The district court reasoned that the boiling points of dioxane (56.5°C) and water (60.1°C) at the reaction pressure of 150 Torr were below the reaction temperature in the second stage of the Sumitomo processes (62.5° ± 1°C). Dow, No. 96-10330, slip. op. at 8 (June 20, 2000).

The district court also held that the Sumitomo processes did not infringe under the doctrine of equivalents for three reasons. Dow, No. 96-10330, slip. op. at 25 (June 20, 2000). First, the district court ruled that there was no evidence of equivalence regarding the first KOH stage of the Sumitomo processes.[5] The district court reasoned that the infringement analysis must compare both stages of the Sumitomo processes with the claimed process, because the first KOH stage is not a mere "colorable variation" or "extraneous" limitation of the entire Sumitomo process. Second, the district court ruled that Dow failed to demonstrate "the interchangeability of dioxane and the solvents" claimed in the '255 patent. The district court reasoned that "Dow's evidence does not show that the '255 patent process would work with the use of dioxane in the place of the solvents identified in Dow's patent."[6] Third, the district court determined, based on arguments

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thermometer in the vapor above the boiling liquid, such that the temperature of the codistillate vapor is measured.

[5] Indeed, Dow did not argue before the district court that the first stages of the Old and New DOX Sumitomo processes infringe claim 1 of the '255 patent. On appeal, Dow also concedes that the first stages of the Sumitomo processes do not infringe.

[6] The district court's determination on this issue is based, in part, on its construction of the phrase "organic solvent" as used in claim 1. The parties do not dispute the construction of this phrase. The district court construed this phrase to mean:

> Those organic compounds which do not significantly react with any component in the reaction mixture, and are partially or wholly miscible with water such that when subjected to the reaction conditions of the claimed

contained in the prosecution history, that Dow was estopped from claiming a process that adds alkali metal hydroxide in two distinct steps.[7] The district court reasoned that Dow surrendered equivalence of a two-step process when it argued during the prosecution of the '255 patent that a prior art patent cited by the examiner "requires two distinctive steps [and] simply highlights how fundamentally different the [prior patent] process is."

Dow timely appealed to this court. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(1) (1994).

> invention, a suitable product in accordance with the object of the invention may be obtained.

Because its construction of "organic solvent" requires the production of a "suitable product," the district court reasoned that Dow failed to demonstrate that the '255 patent process "would work with the use of dioxane in the place of the solvents identified in Dow's patent." The district court's determination on this issue is also predicated on the exclusion of certain expert testimony submitted by Dow. This expert testimony discussed experiments conducted to demonstrate the interchangeability of dioxane and the claimed solvent. The district court excluded this testimony. Dow argues that the district court erred by excluding this testimony. For the reasons discussed herein, we need not decide whether the district court abused its discretion by excluding it. However, the district court should conduct additional factfinding proceedings in accordance with the proper claim construction discussed below.

[7] During reexaminations of the '255 patent, the examiner made certain statements when he allowed the patent to issue in light of British patent No. 1,277,668 ("the British patent"). Specifically, the examiner stated:

> The British patent teaches a method of making epoxides, wherein the differences between [the '255 patent] and [the British patent] is 1) it is a two stage process, 2) [the British patent] teaches a solid NaOH, and 3) [the British patent] does not use the same solvent . . . . The two stage process is required to obtain [the British patent's] desired product. Comparative examples which use a single stage are disclosed, wherein one obtains low yield. Hence one would not be motivated to use such a single stage process, in view of these examples . . . . In conclusion, it appears that all of the cited art discloses many of the features of the ['255 patent], but always lack[s] at least one of the claimed limitations, whether it be temperature, the solvent, one step process, the water content . . . . (emphasis added).

Dow responded to these statements, and noted that the examiner misspoke. Dow stated that the examiner agreed that, "the claimed invention is not limited to a one stage or single step process." As discussed infra, these statements by the examiner do not

II. STANDARD OF REVIEW

We review the grant of a motion for summary judgment de novo, drawing all reasonable factual inferences in favor of the nonmoving party. Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 255 (1986); Axelrod v. Phillips Academy, 74 F. Supp. 2d 106, 108 (D. Mass. 1999). Summary judgment "shall be rendered forthwith if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." Fed. R. Civ. P. 56(c).

The determination of infringement is a two-step process. First, the court construes the claims to correctly determine the scope of the claims. Second, it compares the properly construed claims to the accused device. Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1454, 46 USPQ2d 1169, 1172 (Fed. Cir. 1998) (en banc). Claim construction is a matter of law that we review de novo, without deference to the district court. Id. at 1456, 46 USPQ2d at 1172-73.

However, a determination of infringement, both literal and under the doctrine of equivalents, is a question of fact. Insituform Techs., Inc. v. Cat Contracting, Inc., 161 F.3d 688, 692, 48 USPQ2d 1610, 1614 (Fed. Cir. 1998). Thus, viewing the facts and inferences in the light most favorable to Dow, summary judgment is proper only if "no reasonable jury could return a verdict for the nonmoving party." Anderson, 477 U.S. at 255. Finally, the determination of infringement under the doctrine of equivalents is limited by two primary legal doctrines: (1) prosecution history estoppel and (2) the "all elements" rule. The application of these legal limitations is reviewed by this court de novo. Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 586, 56 USPQ2d 1865, 1886

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constitute a clear and unmistakable surrender of a two-stage process necessary to invoke argument-based prosecution history estoppel.

(Fed. Cir. 2000) (en banc), cert. granted, 69 U.S.L.W. 3673 (U.S. June 18, 2001) (No. 00-1543).

III. DISCUSSION

A. Claim Construction

"It is well-settled that, in interpreting an asserted claim, the court should look first to the intrinsic evidence of record, i.e., the patent itself, including the claims, the specification and, if in evidence, the prosecution history. Such intrinsic evidence is the most significant source of the legally operative meaning of disputed claim language." Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582, 39 USPQ2d 1573, 1576 (Fed. Cir. 1996).

We look first to the claim language itself, to define the scope of the patented invention. Id. As a starting point, we give claim terms their ordinary and accustomed meaning as understood by one of ordinary skill in the art. Hockerson-Halberstadt, Inc. v. Avia Group Int'l, Inc., 222 F.3d 951, 955, 55 USPQ2d 1487, 1490 (Fed. Cir. 2000). Accordingly, a technical term used in a patent claim is interpreted as having the meaning a person of ordinary skill in the field of the invention would understand it to mean. Interactive Gift Express, Inc. v. Compuserve Inc., 2001 WL 792669, *7 (Fed. Cir. July 13, 2001). Dictionaries and technical treatises, which are extrinsic evidence, hold a "special place" and may sometimes be considered along with the intrinsic evidence when determining the ordinary meaning of claim terms. Id. at *6 n.1; see also Cybor Corp., 138 F.3d at 1459, 46 USPQ2d at 1177 (stating that, although technically extrinsic evidence, dictionaries may be consulted at any time to help determine the meaning of claim terms); AFG Indus. v. Cardinal, 239 F.3d 1239, 1248, 57 USPQ2d 1776, 1783 (Fed. Cir. 2001) (noting that non-scientific dictionaries are less preferable when defining technical words); Oak Tech., Inc. v. Int'l Trade Comm'n, 248 F.3d 1316, 1320-1326, 58 USPQ2d 1748, 1750-56 (Fed. Cir. 2001) (relying on technical treatise to determine the ordinary meaning of certain claim limitations). We have previously cautioned against the use of non-scientific dictionaries, "lest dictionary definitions . . . be converted into technical terms of art having legal, not

linguistic significance." Multiform Desiccants, Inc. v. Medzam, Ltd., 133 F.3d 1473, 1478, 45 USPQ2d 1429, 1433 (Fed. Cir. 1998); see also AFG Indus., 239 F.3d at 1247-48, 57 USPQ2d at 1783 (observing that non-scientific dictionary definitions of ordinary words are rarely dispositive of their meanings in a technological context). However, we have never held that non-scientific dictionaries cannot be used to determine the ordinary meaning of claim language. Moreover, technical terms often have an "ordinary meaning" as understood by one of ordinary skill in the art, although these same terms may not be readily familiar to a judge, or may be familiar only in a different context. Thus, in determining the ordinary meaning of a technical term, courts are free to consult scientific dictionaries and technical treatises at any time. Vitronics, 90 F.3d at 1584 n.6, 39 USPQ2d at 1578 n.6.

Furthermore, "[a]lthough words in a claim are generally given their ordinary and customary meaning, a patentee may choose to be his own lexicographer and use terms in a manner other than their ordinary meaning." Vitronics, 90 F.3d at 1582, 39 USPQ2d at 1576. Therefore, the court must examine the intrinsic evidence to determine whether the patentee has given the term an unconventional meaning. Hockerson, 222 F.3d at 955, 55 USPQ2d at 1490. The specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication. Vitronics, 90 F.3d at 1582, 39 USPQ2d at 1577. "Thus, the specification is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term." Id. Moreover, any definition found in or ascertained by a reading of the intrinsic evidence may not be contradicted by any meaning found in dictionaries or technical treatises. Id. at 1584 n.6, 39 USPQ2d at 1578 n.6.

We must also examine the prosecution history to determine whether the patentee has "relinquished a potential claim construction in an amendment to the claim or in an argument to overcome or distinguish a reference." Interactive Gift, 2001 WL 792669 at *6.

The prosecution history contains the complete record of all the proceedings before the Patent and Trademark Office, including any express representations made by the applicant regarding the scope of the claims. Vitronics, 90 F.3d at 1582, 39 USPQ2d at 1577.

If the meaning of the claim limitation is apparent from the intrinsic evidence, it is improper to rely on extrinsic evidence other than that used to ascertain the ordinary meaning of the claim limitation. Id. However, in the rare circumstance that the court is unable to determine the meaning of the asserted claims after assessing the intrinsic evidence, it may look to additional extrinsic evidence to help resolve any lack of clarity. Id. at 1584, 39 USPQ2d at 1578. Additional extrinsic evidence includes such evidence as expert testimony, articles, and inventor testimony. Id. This extrinsic evidence may be used only to assist in the proper understanding of the disputed limitation; it may not be used to vary, contradict, expand, or limit the claim language from how it is defined, even implicitly, in the specification or file history. Id. at 1584-85, 39 USPQ2d at 1579.

1. Construction of the "Boiling Point" Limitation

Dow challenges the district court's claim construction of the codistillate boiling point limitation used in clause 1.[8] Specifically, Dow contends that the "boiling point" phrase involves a simple and practical relative comparison in which the codistillate (consisting of the organic solvent, epi, and water) has a boiling point below that of other components in the mixture, and vaporizes before the other components. Thus, under Dow's preferred construction, one need not actually compare the numerical boiling point of the codistillate to that of the components. In the alternative, Dow argues that any numerical measurement of the codistillate boiling point must be taken in the vapor phase. In other words, Dow contends that the district court improperly construed the boiling point of the codistillate to require measurement of the reaction temperature in the reaction pot. Dow contends that it is well known to one of ordinary skill in the art that the true boiling point of a codistillate should be measured in the vapor phase.

Clause 1 requires that the reaction be conducted "in the presence of an organic solvent which codistills with water and said epihalohydrin at a boiling point below the boiling point of the lowest boiling compound among the components in the reaction mixture." Dow contends that this limitation simply requires the codistillate to boil before the other components in the reaction mixture. Because one of the key components of the improvement process is maintaining the water content in the reaction mixture below six percent by weight, Dow asserts that one of ordinary skill in the art would understand that the boiling point limitation simply requires the codistillate (containing water) to boil before the other components. It may well be true that one of ordinary skill in the art would understand that clause 1 simply requires the codistillate to boil before the other components in the

reaction mixture, nevertheless, as the district court noted, "clause 1 does not state that the codistillate must boil off before the individual components evaporate from the reaction mixture." Dow, No. 96-10330, slip. op. at 35 (Jan. 21, 2000). Instead, clause 1 specifically requires the organic solvent, water, and epi to codistill "at a boiling point below the boiling point of the lowest boiling compound among the components in the reaction mixture." '255 patent, col. 11, ll. 8-12. Thus, as written, clause 1 requires a numerical comparison between the boiling point of the codistillate and the lowest boiling compound in the reaction mixture.

The district court also reasoned that a numerical comparison is required because "clause 1 of claim 1 was developed on the model of a minimum boiling azeotrope." [9] Dow, No. 96-10330, slip. op. at 35 (Jan. 21, 2000). The district court noted that in the grandparent and parent applications of the '255 patent, the phrase "ternary azeotrope"

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[8] The "boiling point" is the temperature of a liquid at which its vapor pressure is equal to or very slightly greater than the atmospheric pressure of the environment. Hawley's Condensed Chemical Dictionary 153 (13th ed. 1997).

[9] An azeotropic mixture is a liquid mixture of two or more substances that behaves like a single substance in that the vapor produced by partial evaporation of liquid has the same composition as the liquid. The constant boiling mixture exhibits either a maximum or minimum boiling point as compared with other mixtures of the same substances. Hawley's Condensed Chemical Dictionary 104 (13th ed. 1997). An azeotropic mixture with a minimum boiling point is a rare mixture that has a boiling point below those of its constituent components, and thus boils before its components. Therefore, the district court reasoned that a numerical comparison is necessary "in order to give meaning to the [disputed] phrase" because an azeotropic mixture with a maximum boiling point would contradict the literal language of the limitation.

was used instead of the word "codistillate." Although our construction requires a numerical comparison of boiling points, this determination is not based on the fact that the claim language was "developed on the model of" an azeotropic mixture. Dow, No. 96-10330, slip. op. at 35 (Jan. 21, 2000). The fact that the claim language was changed from "ternary azetrope" to "codistillate" in the continuation-in-part application suggests that the terms have different meanings. Indeed, Sumitomo's experts admit that an azeotropic mixture has a "constant composition," and if the "composition is changing at a defined temperature and pressure, then the composition changing would not be an azeotrope." Because the compositions involved in the claimed process constantly change during the process, the codistillate disclosed in claim 1 of the '255 patent is not an azeotropic mixture.

Although the construction of the "boiling point" limitation used in clause 1 requires a numerical comparison of boiling points, we conclude based on the following reasoning that the district court was incorrect in ruling that the codistillate boiling point is determined by measuring the temperature of the reaction mixture. Rather, the boiling point of the codistillate is properly measured in the vapor phase. We start with the proposition that the boiling point of a codistillate must be given its ordinary meaning as understood by one of ordinary skill in the art. Interactive Gift, 2001 WL 792669 at *7; Hockerson-Halberstadt, 222 F.3d at 955, 55 USPQ2d at 1490. In determining whether the codistillate boiling point is properly measured in the vapor phase or in the reaction mixture, we are free to consult technical treatises so long as such treatises do not contradict any definition found in or ascertained by a reading of the intrinsic evidence. Interactive Gift, 2001 WL 792669 at *6 n.1; Vitronics, 90 F.3d at 1584 n.6, 39 USPQ2d at 1578 n.6.

Dow contends that compounds that are not part of the codistillate, such as novolac and the alkali metal hydroxide, decrease the overall vapor pressure of the mixture (notwithstanding superheating or other impurities), thus requiring a higher reaction

temperature to commence boiling.[10] Thus, Dow argues that one of ordinary skill in the art would understand that the true boiling point of the pure codistillate (consisting of organic solvent, epi, and water) must be measured in the vapor phase. Accordingly, Dow has submitted various technical treatises explaining that the boiling point of the pure codistillate is properly measured in the vapor phase. One such treatise explains that: "[A] thermometer immersed in the boiling liquid will . . . record a temperature a little above the boiling point. A thermometer in the vapor space, however, records the true boiling point even if the liquid is superheated or if it contains a nonvolatile solvent." Louis F. Fieser, Organic Experiments 23 (Heath 1964) (emphasis added).

A number of other treatises use the example of the distillation of a sugar and water solution to explain why the distillate boiling point must be measured in the vapor phase. One treatise explains that when "a solution of sugar in water is distilled, the

[10] Sumitomo agrees that the codistillate consists only of epi, solvent, and water, and that clause 1 requires codistillation "of these three components, and each component alone cannot boil off from the reaction mixture to the extent that codistillation occurs."

boiling point

recorded on a thermometer located in the vapor phase is 100°C ... throughout the distillation, whereas the temperature of the boiling sugar solution itself is initially somewhat above 100°C and continues to rise as the concentration of sugar in the remaining solution increases." Kenneth L. Williamson, Macroscale and Microscale Organic Experiments 85-86 (Heath 2d ed. 1994) (emphasis added). An increased concentration of nonvolatile constituents in a mixture decreases the vapor pressure in a solution. When the vapor pressure of a solution decreases, a higher reaction mixture temperature is required for boiling. Id. However, the true boiling point of the pure distillate never changes, and must be measured in the vapor phase. Id.

Sumitomo points to one reference that criticizes the procedure of measuring the boiling point of a codistillate in the vapor phase as "of dubious value." Hala et al., Vapour-Liquid Equilibrium 253 (2d English ed. 1967). Yet the same reference also strongly criticizes the method of measuring the temperature of the liquid as "weighted with errors" because "the boiling liquid is always superheated" and "[t]his source of error cannot even be diminished."[11] Id. Sumitomo cites no other technical treatise to refute the proposition that one of ordinary skill in the art would understand the ordinary meaning of the boiling point of the codistillate to entail measuring the temperature of the vapor phase.

[11] The Hala reference actually describes a Cottrell measuring apparatus that measures the temperature in the vapor phase, but uses a sheath to prevent cold condensate from reaching the thermometer which causes a "deviation of the condensation temperature from the boiling point." Id.

Furthermore, that the ordinary meaning of the codistillate boiling point entails measuring the temperature of the codistillate in the vapor phase is supported by the ordinary definition of the term "distillate." As discussed above, distillation is "a separation process in which a liquid is converted to a vapor and the vapor then condensed to a liquid. The latter is referred to as the distillate, while the liquid material [is the] distilland." Hawley's Condensed Chemical Dictionary 418 (13th ed. 1997) (emphasis added). Claim 1 of the '255 patent specifically calls for measuring the boiling point of the distillate, not the distilland. Moreover, one of ordinary skill in the art would understand that the temperature of the reaction mixture would likely be higher than the true codistillate boiling point due to superheating or contamination with other substances that do not evaporate. Therefore, it is clear that the ordinary meaning of the codistillate boiling point as used in claim 1 entails the measurement of the codistillate in the vapor phase.

We next examine the intrinsic evidence to determine whether the patentee has given the term an unconventional meaning based on any definition found in or ascertained by a reading of the intrinsic evidence. Vitronics, 90 F.3d at 1584 n.6, 39 USPQ2d at 1578 n.6. The district court stated that, "the intrinsic evidence does not distinguish between a distillate boiling point and the reaction mixture temperature, and does not teach that any temperature should be measured in the vapor phase." Dow, No. 96-10330, slip. op. at 9 (Apr. 19, 2000). However, the question before us is not whether the '255 patent teaches that the boiling point should be measured in the vapor phase; as discussed above, one of ordinary skill in the art would understand that the ordinary meaning of a codistillate boiling point involves measuring the temperature in the vapor phase. Instead, the question is whether the '255 patent sufficiently redefines the meaning of "boiling point" such that one of ordinary skill in the art would believe that it is measured in the reaction mixture.

The district court observed that, "the only notations of temperature [in the '255 patent specification] relate to the reaction mixture." Dow, No. 96-10330, slip. op. at 9 (Apr. 19, 2000). The district court reasoned that, "when identifying the temperature of the reaction mixture in conjunction with the pressure, the examples are clearly referring to the boiling point." Id. at 10. We agree that all of the examples described in the '255 patent specification discuss the reaction temperature. However, we disagree that the specification equates the temperature of the reaction mixture with the codistillate boiling point disclosed by claim 1. The '255 patent specifically uses the phrase "boiling point" in claim 1. '255 patent, col. 11, ll. 8-15. The specification also explains that the codistillate "has a boiling point below that of the lowest boiling component of the reaction mixture at the pressure employed." '255 patent, col. 5, ll. 28-30. At the same time, the '255 patent specification discusses the "reaction temperature" of the reaction mixture in numerous instances when it describes the preferred embodiment experiments. However, as discussed above, the ordinary meaning of the reaction temperature is different than the ordinary meaning of the boiling point of the codistillate. The fact that the '255 patent specification also describes the reaction temperature is consistent with the different meanings of these phrases.

That the specification identifies the reaction temperature in conjunction with a notation of the pressure does not signify that "the examples are clearly referring to the boiling point." Dow, No. 96-10330, slip. op. at 10 (Apr. 19, 2000). Indeed, one example describes an experiment where the reaction temperature is maintained at 65°C, yet the reaction pressure is varied between 180 and 240 mm Hg absolute. '255 patent, col. 10, ll. 26-55. As discussed above, because the boiling point of a codistillate is necessarily

defined by a fixed vapor pressure at a fixed temperature the reaction temperature of 65° used in this example cannot be the same as the codistillate boiling point.[12]

Finally, we note with great significance that the district court's construction would exclude many of the preferred embodiment experiments. Dr. Lowery's declaration of February 3, 2000 explains that equating the codistillate boiling point with the reaction temperature would exclude six examples from the scope of the claims.[13] Sumitomo conceded at oral argument that the district court's construction excludes six of the preferred embodiments described by the '255 patent specification.[14] Indeed, even the

[12] The district court came to the opposite conclusion, reasoning that "the variation of the pressure in order to maintain the reaction temperature at 65° C refutes, rather than supports, Dow's proposed construction." Dow, No. 96-10330, slip. op. at 11 (Apr. 19, 2000). We disagree. Having determined that the ordinary meaning of a codistillate boiling point entails measuring the codistillate in its vapor phase, the question becomes whether the specification redefined "boiling point" to mean the reaction temperature. This example describes maintaining the reaction temperature at 65° C while varying the reaction pressure. This example is consistent with the different meanings of the codistillate boiling point and the reaction temperature, and does not implicitly redefine the meaning of the boiling point limitation used in claim 1.

[13] In determining whether a preferred embodiment is excluded by a certain claim construction, we may look to extrinsic evidence so long as the extrinsic evidence does not "contradict the meaning otherwise apparent from the intrinsic evidence." Pitney Bowes, Inc. v. Hewlett-Packard Co., 182 F.3d 1298, 1309, 51 USPQ2d 1161, 1169 (Fed. Cir. 1999).

[14] We note that Dr. Lowery's declaration of May 9, 2000 states that the district court's construction actually excludes nine of fifteen preferred embodiment experiments. However, because the district court excluded Dr. Lowery's May 9, 2000 declaration as untimely, we do not rely on it.

district court recognized that its construction would "exclude certain examples from the claim." Dow, No. 96-10330, slip. op. at 13 (Apr. 19, 2000). In response, Sumitomo argues that, "there is no requirement that claims be construed to include every embodiment disclosed in the specification."[15]

It is axiomatic that "[c]laims, not the specification embodiments, define the scope of protection." American Permahedge, Inc. v. Barcana, Inc., 105 F.3d 1441, 1444, 41 USPQ2d 1614, 1617 (Fed. Cir. 1997). However, it is also well established that a claim construction that excludes a preferred embodiment is "rarely, if ever, correct." Vitronics, 90 F.3d at 1583, 39 USPQ2d at 1578 (emphasis added); see also Interactive Gift, 2001 WL 792669 at *19. This is because "it is unlikely that an inventor would define the invention in a way that excluded the preferred embodiment, or that persons of skill in this field would read the specification in such a way." Hoechst Celanese Corp. v. BP Chem. Ltd., 78 F.3d 1575, 1581, 38 USPQ2d 1126, 1130 (Fed. Cir. 1996).

The claim language calls for the measurement of the boiling point of the codistillate. One of ordinary skill in the art would understand that the ordinary meaning of a codistillate boiling point entails measuring the temperature of the codistillate in the

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[15] Sumitomo attempts to rely on Pitney Bowes, Inc. v. Hewlett-Packard Co., 182 F.3d 1298, 1310, 51 USPQ2d 1161, 1169-70 (Fed. Cir. 1999), and argues that forty-two of forty-four uses of a term in a specification were excluded in that case. However, Sumitomo misstates the holding of our decision in Pitney Bowes. In that case, we held only that it was acceptable for certain portions of the specification to use a term differently than it was used in the claim. We reasoned that the intrinsic evidence put "the reader on notice that the term 'spot' has different meanings in the written description depending on its context." Pitney Bowes, 182 F.3d at 1311, 51 USPQ2d at 1170. We did not, as Sumitomo seems to argue, hold that the properly construed term excluded forty-two of forty-four uses of the term in the specification.

vapor phase. The intrinsic evidence does not reveal that the patentee has given the term an unconventional meaning as ascertained by a reading of the patent documents. Vitronics, 90 F.3d at 1584 n.6, 39 USPQ2d at 1578 n.6. Therefore, the meaning of the claim limitation is apparent from a review of the intrinsic evidence alone, and it is improper for us to rely on extrinsic evidence other than that used to determine the ordinary meaning. Id. Finally, our construction is bolstered by the fact that the alternative would exclude many of the preferred embodiments.

2. Construction of the "Continuous/Continuously" Limitation

Dow also challenges the district court's claim construction of the words "continuous" and "continuously" as used in clauses 3 and 4.[16] Specifically, Dow contends that these terms as used in clauses 3 and 4 do not require "distillation to take place throughout the duration of the addition of caustic." Dow, No. 96-10330, slip. op. at 20 (Apr. 19, 2000). The district court reasoned that, "a natural reading of clauses 3 and 4 leave the reader with the impression that water is supposed to be continuously

[16] Dow also argues that the district court erred by improperly construing the phrase "continuously removing water" to extend to "steps carried out prior to the claimed process conditions." However, the district court agreed with Dow that "[t]he written submissions that Dow made directly to the reexaminer contradict Sumitomo's claim that Dow argued that '255 was a one step process." Dow, No. 96-10330, slip. op. at 46-47 (Jan. 21, 2000). Specifically, Dow stated that, "as the Examiner agreed, the claimed invention is not limited to a one stage or single step process." Id. (emphasis added). It is clear that the construction of claim 1 is not limited to a single stage process.

However, inasmuch as the district court required a comparison of the claimed process to both stages of the Sumitomo process this issue is considered, infra, as part of our discussion regarding the proper scope of the infringement analysis.

removed during the period of time in which the aqueous solution is being added." Dow, No. 96-10330, slip. op. at 20 (Apr. 19, 2000). In other words, under the district court's construction, distillation must begin simultaneously with the addition of the alkali metal hydroxide described in clause 3.

Dow also argues that the district court's construction excludes all of the preferred embodiments because when the alkali metal hydroxide is added, there is a short delay before the water level requires distillation. Dow contends that it would have been "clear to a person of ordinary skill in the art" that "codistillation would not necessarily occur simultaneously with the very first addition of caustic." The district court rejected Dow's expert testimony on this issue, reasoning that it "may not be used to vary or contradict the claim language or specifications." Dow, No. 96-10330, slip. op. at 21 (Apr. 19, 2000).

The plain language of the claim does not support the district court's construction that claim 1 "requires distillation to take place throughout the duration of the addition of caustic." Clause 3 states:

> employing said alkali metal hydroxide as an aqueous solution and adding said aqueous alkali metal hydroxide in a continuous or intermittent manner over a period of from about 0.5 to about 10 hours . . .

'255 patent, col. 11, ll. 16-19. Clause 4 states:

> continuously removing water by means of codistillation at a rate such that the water content in the reaction mixture is less than about 6 percent by weight . . .

'255 patent, col. 11, ll. 20-23.

The plain language of clause 3 requires the addition of the alkali metal hydroxide in a continuous or intermittent manner. The plain language of clause 4 simply requires the continuous removal of water by means of codistillation. There is nothing in the language of claim 1 requiring the continuous removal of water described in clause 4 to begin simultaneously with the addition of alkali metal hydroxide described in clause 3. The

district court placed great emphasis on certain language contained in the '255 patent specification:

> Example 1 states, "During the addition of the [alkali metal] hydroxide, the water is removed by codistilling with epichlorohydrin and solvent." Example 5 provides, "During the addition of [alkali metal hydroxide], the water was removed by codistilling with epichlorohydrin and 1-methoxy-2-hydroxy propane." Finally, in example 10, it was stated, "During the addition of the [alkali metal] hydroxide, the water was removed by codistilling with epichlorohydrin and solvent."

Dow, No. 96-10330, slip. op. at 45 (Jan. 21, 2000). This language contained in the specification does not require distillation to begin simultaneously with the addition of the alkali metal hydroxide. Instead, this language simply states that distillation occurs during the addition of the alkali metal hydroxide. Distillation that occurs "during" the addition of the alkali metal hydroxide (as stated in the specification) is significantly different from distillation that occurs "throughout the duration" of the addition of the alkali metal hydroxide (as required by the district court). By requiring distillation to take place "throughout the duration of the addition of caustic," the district court improperly imported a limitation not supported by the claim language or the specification. Comark Communications, Inc. v. Harris Corp., 156 F.3d 1182, 1186, 48 USPQ2d 1001, 1005 (Fed. Cir. 1998).

The claim language of clause 4 calls only for the continuous removal of water by codistillation. Clause 4 does not require distillation to commence simultaneously with the addition of the alkali metal hydroxide. This construction is consistent with the definition of "continuous" that once distillation begins, it continues "without cessation." Dow, No. 96-10330, slip. op. at 46 (Jan. 21, 2000). This construction is also apparent from a reading of the intrinsic evidence alone, and therefore, it is improper for us to rely on other extrinsic evidence.

B. Infringement Analysis

As discussed above, the district court determined that the Sumitomo processes did not literally infringe claim 1 of the '255 patent for three reasons. Dow, No. 96-10330, slip. op. at 8 (June 20, 2000). However, two of the three reasons were premised on an erroneous understanding of the proper scope of the infringement analysis.[17] In conducting its infringement analysis, the district court compared the process claimed by the '255 patent with both stages of the Sumitomo processes. The district court determined that "[t]he first stages of the [Sumitomo] processes cannot be disregarded." Id. at 16. The district court reasoned that Dow had not demonstrated that the first stages of the Sumitomo processes were "merely colorable variations," "unimportant and insubstantial changes and substitutions," or "extraneous limitations." Id. at 17. Therefore, the district court ruled that the '255 patent process must be compared with both stages of the Sumitomo processes because it could not deem the first stages "unimportant." Id. at 17-18.

In so holding, the district court relied on language from our decision in Amstar Corp. v. Envirotech Corp., 730 F.2d 1476, 1483, 221 USPQ 649, 654 (Fed. Cir. 1984). In Amstar, we stated that an accused product did not escape infringement simply because it contained additional modifications and "merely colorable variations" in addition to the claimed limitations. Id. at 1483, 221 USPQ at 654. This language used in Amstar simply recognized that the accused product in that case was "the same" as the claimed invention

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[17] As discussed supra, the district court ruled that, in the New DOX process, water is not removed "throughout the duration of the addition of caustic" because "KOH is added during the first stage without simultaneous distillation." Dow, No. 96-10330, slip. op. at 8 (June 20, 2000) (emphasis added). The district court also noted that the reaction mixture temperature of the first stage of the Old and New DOX processes is maintained at 39° C ± 1° C, which is below the 45° C to about 80° C as required by clause 2 of claim 1. Id. (emphasis added).

These two determinations are based on a comparison of both stages of the Sumitomo processes with the claimed process. We note that Dow has never argued that

and already contained the claimed limitations. Id. at 1483-84, 221 USPQ at 653-54. This language does not alter the well-established principle that the "mere addition of elements [in the accused product or process] cannot negate infringement." Id. at 1482, 221 USPQ at 653.

The preamble of claim 1 of the '255 patent ends with the phrase "which comprises." '255 patent, col. 11, l. 7. It is fundamental that the use of this phrase as a transitional phrase "does not exclude additional unrecited elements, or steps (in the case of a method claim)." Moleculon Research Corp. v. CBS, Inc., 793 F2d 1261, 1271, 229 USPQ 805, 812 (Fed. Cir. 1986). Thus, an accused method "does not avoid literally infringing a method claim . . . simply because it employs additional steps." Id. (emphasis in original); see also Vivid Tech., Inc. v. Am. Sci. & Eng'g, Inc., 200 F.3d 795, 811, 53 USPQ2d 1289, 1301 (Fed. Cir. 1999) ("[A claim using] the signal 'comprising' . . . is generally understood to signify that the claims do not exclude the presence in the accused apparatus or method of factors in addition to those explicitly recited"); Phillips Petroleum Co. v. Huntsman Polymers Corp., 157 F.3d 866, 874, 48 USPQ2d 1161, 1167 (Fed. Cir. 1998) ("The use of . . . 'which comprises' in the composition and process claims generally would mean that the claims require [the recited limitations], but that additional elements or process steps may be present."); Genentech, Inc. v. Chiron Corp., 112 F.3d 495, 501, 42 USPQ2d 1608, 1613 (Fed. Cir. 1997) ("'Comprising' is a term of art used in claim language which means that the named elements are essential, but other elements may be added and still form a construct within the scope of the claim.").

It is clear that the process described by claim 1 of the '255 patent is part of a larger process that may encompass preliminary or subsequent steps. In addition to using the

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the first stages of the Sumitomo processes infringe claim 1 of the '255 patent. Moreover, for the reasons discussed, infra, such an infringement analysis is improper.

phrase "which comprises," the claimed process is written in Jepson format, and describes certain conditions as an improvement over a well known process. In such a case, an accused process does not avoid infringement by adding additional steps, regardless of whether such steps are "extraneous" or mere "colorable variations." Therefore, the Sumitomo processes infringe even if only the second stages of the Old and New DOX processes meet the limitations contained in claim 1 of the '255 patent.

Consistent with our claim construction, on remand, the district court should determine whether the second stage of the Sumitomo processes literally infringe claim 1 of the '255 patent. Sumitomo does not dispute that the second stages of its Old and New DOX processes meet every limitation of claim 1 except for the "boiling point" and "solvent" limitations contained in clause 1. Based on our construction of the "boiling point" limitation, only Dow has submitted evidence regarding the codistillate boiling point as measured in the vapor phase.[18] However, we recognize that under the district court's claim construction, Sumitomo need not have submitted evidence regarding the boiling point of the codistillate as measured in the vapor phase. Therefore, on remand, the district court should conduct further fact-finding to determine the boiling point of the pure codistillate used in the second stage of the Sumitomo processes, as measured in the vapor phase.

If the district court determines that the boiling point of the codistillate used in the second stages of the Sumitomo processes, as measured in the vapor phase, is below the boiling point of the lowest boiling compound among the components in the reaction

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[18] Sumitomo's expert admitted that he had "not determined" the boiling point of the "pure" (vapor phase) codistillate in the second stage of the Sumitomo processes. However, Dr. Lowery testified in his initial expert report that the codistillate boiling point (as measured in the vapor phase) of the second stage of the Sumitomo processes "ranges from about 50° C to about 54° C." This temperature range is below the boiling points of dioxane (56.5° C) and water (60.1° C) at the reaction pressure of 150 Torr, as recognized by the district court. Dow, No. 96-10330, slip. op. at 5 (June 20, 2000). According to Dr.

mixture, then Sumitomo literally infringes if dioxane is an organic solvent as construed by the district court.[19] On remand, the district court should conduct further fact-finding to determine whether dioxane "does not significantly react with any component in the reaction mixture, and [is] partially or wholly miscible with water such that when subjected to the reaction conditions of the claimed invention, a suitable product in accordance with the object of the invention [is] obtained."

Finally, under our construction, the district court may not necessarily reach the issue of infringement under the doctrine of equivalents. Nevertheless, we note that Dow is not barred by the legal doctrine of prosecution history estoppel from claiming that the Sumitomo processes are equivalent to the '255 patent process. The district court incorrectly compared the claimed process to both stages of the Sumitomo processes. Based on certain statements made during the reexamination of the '255 patent, the district court reasoned that Dow was estopped from arguing that a two stage process infringed under the doctrine of equivalents. Dow, No. 96-10330, slip. op. at 23-24 (June 20, 2000). As discussed above, however, the Sumitomo processes infringe claim 1 of the '255 patent if the second stage alone meets the claim limitations either literally or under the doctrine of equivalents.

We note that statements made by an examiner will not necessarily limit a claim. Eastman Kodak Co. v. Goodyear Tire & Rubber Co., 114 F.3d 1547, 1556, 42 USPQ2d 1737, 1743 (Fed. Cir. 1997), overruled on other grounds by Cybor Corp., 138 F.3d 1448, 46 USPQ2d 1169 (ignoring limiting statements made by an examiner where such limitations were not found in the claim language). Where a patentee disputes an

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Lowery's testimony, the second stage of the Sumitomo processes meets the "boiling point" limitation contained in clause 1.

[19] As discussed above, neither party disputes the meaning of "organic solvent" as construed by the district court.

examiner's statement on the record, and makes no amendment based on the examiner's statement, such statement usually would not be construed as a basis for argument-based prosecution history estoppel. Moreover, Dow made clear in its response that, "as the Examiner agreed, the claimed invention is not limited to a one stage or single step process." Dow, No. 96-10330, slip. op. at 47 (Jan. 21, 2000). In the same statement, Dow attempted to clarify the previous comment made by the examiner, noting that: "This statement demonstrates why one skilled in the art would not be motivated to substitute aqueous NaOH for the solid NaOH of the [British patent] since the [British patent] process is such a fundamentally different process. Thus, as the [e]xaminer agreed, the claimed invention is not limited to a one stage or single step process." (emphasis added). The statements at issue clearly distinguished the British patent because it used a solid (as opposed to aqueous) alkali metal hydroxide in one of the two stages. However, Dow's statements also attempt to clarify any possible misconception gleaned from the examiner's earlier statement that, "[based on the British patent] one would not be motivated to use such a single stage process." Dow's statements make clear that its invention was not limited to a one step process. Thus, Dow's statements do not evince the "clear and unmistakable surrender of subject matter" necessary to invoke argument-based prosecution history estoppel. Pharmacia & Upjohn Co. v. Mylan Pharms., Inc., 170 F.3d 1373, 1377, 50 USPQ2d 1033, 1036 (Fed. Cir. 1999).

IV. CONCLUSION

For the reasons discussed, the district court's grant of summary judgment of noninfringement in favor of Sumitomo is

VACATED AND REMANDED.

COSTS

No costs.