United States District Court,
M.D. Louisiana.

ALBEMARLE CORPORATION,
v.
GREAT LAKES CHEMICAL CORPORATION. v.

Civil Action Nos. 02-505-A, 02-506-A

Dec. 20, 2007.

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RULING

JOHN V. PARKER**, District Judge.**

This court has carefully considered the complaints, the record, the law applicable to the action, and the Report and Recommendation of United States Magistrate Judge Docia L. Dalby, dated November 2, 2007 (doc. 562). Both parties have filed objections to the Report and Recommendation (docs.563, 566), submitted memoranda in support of their objections (docs.569, 570), and filed responses to the objections (docs.574, 578). Plaintiff, Albemarle, has requested an opportunity to provide oral argument (doc. 574, p. 10), which the court deems unnecessary, since the magistrate judge provided the parties an opportunity to present oral argument at the *Markman* hearing held in conjunction with this matter on March 9, 2007.

The court hereby approves the Report and Recommendation of the magistrate judge and adopts it as the court's own opinion herein.

CONCLUSION

Accordingly, the definitions for those claim terms in need of construction are hereby adopted as set forth in the Report and Recommendation of Magistrate Judge Docia L. Dalby dated November 2, 2007 (doc. 562). Moreover, the parties are ordered to not refer, directly or indirectly, to each other's claim construction positions in the presence of the jury; to refrain from mentioning any portion of the magistrate judge's report and recommendation, other than the actual definitions adopted by the court, in the presence of the jury; and to limit any reference to claim construction proceedings to informing the jury of the definitions adopted by the court.

REPORT AND RECOMMENDATION

DOCIA L. DALBY**, United States Magistrate Judge.**

This matter is before the court on referral from the District Judge for a report and recommendation following a *Markman* hearing, which was held in order to resolve the parties' disputes over the proper claim interpretation to be used in this patent infringement action. Since the interpretation of the claims is a matter of law, the Court must resolve interpretation disputes prior to a jury being given the case for decision. Thus, this report, in essence, recommends the definitions to be used in the jury charges.

In this consolidated lawsuit, the parties have identified disputed claims in five patents. Those five patents can be divided into two areas of technology: (1) the recovery of bromine from brine, and (2) the manufacture and use of brominated flame retardants. Two patents are associated with the recovery of bromine from brine: United States Patent Nos. 4,719,096 (the '096 Patent) and 4,978,518 (the '518 Patent), collectively called "The Bromine Tower Patents." FN1 Three patents are associated with the manufacture and use of brominated flame retardants: United States Patent Nos. 5,077,334 (the ' 334 Patent), 5,030,778 (the '778 Patent), 5,008,477 (the ' 477 Patent), collectively, "The Flame Retardant Patents." FN2

FN1. The Bromine Tower Patents, '096 and '518 are entitled "Continuous Two-Stage Vacuum Process for Recovering Bromine" and "Continuous Vacuum Process for Recovering Bromine," respectively. The ' 096 patent issued from a continuation-in-part application based on the patent application resulting in U.S. Patent 4,725,425 ('425 Patent). No claims are asserted against the '425 Patent, but for purposes of claim construction, both the '425 and '096 applications are considered part of the '096 prosecution history.

FN2. The Flame Retardant Patents are entitled "Decabromodiphenyl Alkane Process" ('477), "Decabromodiphenyl Alkane Process" ('778), and "Flame-Retarded Formulations of Thermoplastics and Decabromodiphenylethane" ('334).

LAW APPLICABLE TO CLAIM CONSTRUCTION

Claim construction is an issue of law for the court to decide. Markman v. Westview Instruments, Inc., 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). "A claim in a patent provides the metes and bounds of the right which the patent confers on the patentee to exclude others from making, using or selling the protected invention." Burke, Inc. v. Bruno Independent. Living Aids, Inc., 183 F.3d 1334, 1340 (Fed.Cir.1999). Thus, where a jury is to make the decision as to whether another has encroached on the "metes and bounds of the right which the patent" has conferred on the patentee, the court must provide the jury with the proper meaning of the claims in the patents.

Although the court can consider both extrinsic and intrinsic evidence in construing the meaning of claims, the Federal Circuit Court has made it clear that extrinsic evidence such as dictionaries, learned treatises, and the testimony of experts and inventors is less significant than intrinsic evidence. Phillips v. AWH Corp., 415 F.3d 1303, 1317 (Fed.Cir.2005). The court's focus should and must be, then, on the intrinsic evidence.

Intrinsic evidence comes from three primary sources in the patent record: the language of the claims themselves; the remaining portion of the patent, *i.e.,* the specifications; and the "prosecution history" or "file history," which is basically the history of proceedings before the patent office. Markman, 52 F.3d 967, 979 (Fed.Cir.1995).

The starting point of all claim construction is the actual language of the claims, for it is this language that determines the scope of the invention. In *Phillips,* the court reiterated that "the claims of a patent define the invention to which the patentee is entitled the right to exclude." Phillip v. AWH Corp., 415 F.3d 1303, 1312 (Fed.Cir.2005), quoting Innova/Pure Water, Inc. v. Safari Water Filtration Systems, Inc., 381 F.3d 1111, 1115 (Fed.Cir.2004). To that end, the words used in a claim "are generally given their ordinary and customary meaning." Phillips, 415 F.3d at 1312 (internal citations omitted).

The ordinary and customary meaning of a claim term "is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, *i.e.,* as of the effective filing date of the patent application." *Id*. This principle of patent law flows naturally from the recognition that inventors are usually persons who are skilled in the field of the invention. The patent is addressed to and intended to be read by others skilled in the particular art. *Id*. Unless this language is ambiguous or has been modified by other intrinsic evidence, the claim language is to be given its ordinary and customary meaning.

Although the claims themselves may provide guidance as to the meaning of particular terms, those terms are still part of "a fully integrated written instrument." Phillips, 415 F.3d 1303, 1315 (quoting Markman, 52 F.3d at 978). Thus, the primacy of claim terms notwithstanding, *Phillips* made clear that "the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." Phillips, 415 F.3d at 1313. In patent law, the specification must contain a written description of the invention that enables one of ordinary skill in the art to make and use the invention. A patent's claims therefore must be read in view of the specification, of which they are a part. *Id*.

As the Supreme Court stated long ago, "in case of doubt or ambiguity it is proper in all cases to refer back to the descriptive portions of the specification to aid in solving the doubt or in ascertaining the true intent and meaning of the language employed in the claims." Bates v. Coe, 98 U.S. 31, 38, 25 L.Ed. 68 (1878). In addressing the role of the specification, the *Phillips* court quoted with approval its earlier observations from Renishaw PLC v. Marposs Societa' per Azioni, 158 F.3d 1243, 1250 (Fed.Cir.1998):

Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. The construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction.

But while *Phillips* emphasized the important role the specification plays in the claim construction process, the courts have never strayed from the premise that it is the function of the claims, not the specification, to set forth the limits of the patentee's claims. Otherwise, there would be no need for claims. SRI Intern. v. Matsushita Elec. Corp. of America, 775 F.2d 1107, 1121 (Fed.Cir.1985). Likewise, although the specification may indicate that certain embodiments are preferred, particular embodiments appearing in the specification will not be read into the claims as limitations when the claim language is broader than the embodiments. Electro Medical Systems, S.A. v. Cooper Life Sciences, Inc., 34 F.3d 1048, 1054 (Fed.Cir.1994).

The third area of intrinsic evidence is the prosecution history, alternately referred to as the "file history," which continues to play an important role in claim interpretation. The prosecution history helps to demonstrate how the inventor and the PTO understood the patent. Phillips, 415 F.3d 1303, 1317 (Fed.Cir.2005). Because the file history, however, "represents an ongoing negotiation between the PTO and the applicant," it may lack the clarity of the specification and thus be less useful in claim construction proceedings. *Id*. Nevertheless, the prosecution history is intrinsic evidence. That evidence is relevant to the determination of how the inventor understood the invention and whether the inventor limited the invention during prosecution by narrowing the scope of the claims.

Claim construction issues are not resolved by any magic formula, and the *Phillips* court did not impose any particular sequence of steps for a court to follow when it considers disputed claim language. Phillips, 415 F.3d at 1324. Rather, *Phillips* held that a court must attach the appropriate weight to the intrinsic sources offered in support of a proposed claim construction, bearing in mind the general rule that the claims measure the scope of the patent grant. The court now turns to a discussion of the claim construction disputes.

THE BROMINE TOWER PATENTS

The two bromine tower patents involve processes for recovering bromine from brine. The parties submitted a joint tutorial on the background technology, which the court now reproduces before moving to the actual claims in dispute in the two patents at issue.

The Bromine Tower Technology

Bromine, having the chemical symbol Br, is an important raw material used to make flame retardants which, in turn, can be added to plastics to reduce the likelihood of combustion in the event of fire. Bromine is present in dilute concentrations in seawater, in more concentrated forms in areas such as the Dead Sea, and in selected underground brines. Underground brines that are useful for bromine recovery are found in only a few places around the world, such as Arkansas, where the brine is pumped out of the ground from depths of about 8,500 feet, and typically have a sodium bromide content of approximately 3,000 to 5,000 parts per million (ppm).

The Bromine found in these brines is in the form of a dissolved bromide salt, usually sodium bromide (NaBr). Bromine in its dissolved salt form is called a *bromide* ion (Br-). The term Bromine can refer to a single Br atom and to the *molecule* Br_2 which contains two bromine atoms. Bromine recovery operations convert the bromide ions in the brine to molecular bromine (Br_2). Bromine (Br_2) is a dark red-brown liquid at room temperature.

A common way to convert bromide ions to molecular bromine is to react the bromide ions with chlorine gas (Cl_2). Chlorine reacts with bromide *ions* according to the chemical reaction shown below. When chlorine reacts with sodium bromide (NaBr), the products are sodium chloride (NaCl) and molecular bromine.

$2NaBr$	+	Cl_2	$\rightarrow$	$2NaCl$	+	Br_2 (REACTION 1)
sodium bromide		chlorine		sodium chloride		molecular bromine

Since the salts in the above reaction are actually dissolved in water, the reaction may also be written:

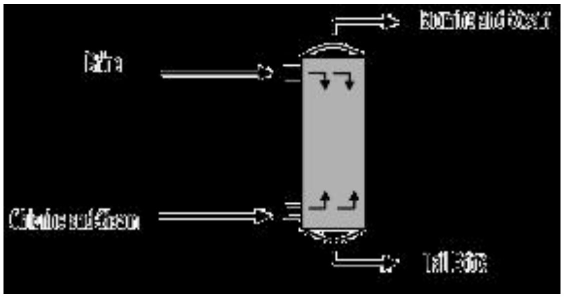
$$2Na^{+} \quad + \quad 2Br^{-} \quad + \qquad \rightarrow \quad 2Na^{+} \quad + \quad 2Cl^{-} \quad + \quad Br_2$$

This reaction results in a solution of water, dissolved sodium chloride and molecular bromine. Molecular bromine has a lower boiling point than water so it can be separated by heating the solution enough to cause the bromine to boil. Although brine that comes from underground wells is already hot, at atmospheric pressure it must be heated further to strip the bromine.

It is a basic principle of chemistry that the boiling points of liquids are affected by the ambient pressure. This is why water boils at 212 (deg.)F in Louisiana, but at a lower temperature in Denver (Denver is at a higher altitude and, as a result, the atmospheric pressure is lower). Similarly, extracting bromine from brine under vacuum permits the bromine to boil or "vaporize" at an even lower temperature. As a result, it is not necessary to heat the brine as much, and vacuum extraction therefore requires less steam and energy to separate the bromine from the brine.

A. Prior Art Kubierschky Process

Beginning around the 1920's, bromine was recovered from bromide-containing brines by the "Kubierschky" process in which liquid brine was introduced at the top of a large tower and a mixture of chlorine gas and steam was introduced at the bottom (see below). A tower used in bromine extraction was typically about ten feet across and 40 feet high.



As the liquid brine descends down the tower, it mixes with the rising mixture of steam and chlorine gas. The chemical reaction described above (Reaction 1) occurs.

Once the bromide is converted to molecular bromine, the molecular bromine remains intermixed in the brine solution and must be separated. The steam introduced in the lower portion of the tower serves two functions; it heats the brine enough to cause the molecular bromine to vaporize and it "strips" the molecular bromine from the brine. Some of the steam and the stripped bromine gas exit the top of the tower, and the bromine is isolated in subsequent steps. The residual brine ("tail brine") exits the bottom of the tower. It is not unusual for the tail brine to still contain some amount of bromine. The tail brine can be further processed or reprocessed to recover additional bromine, chlorine, and/or heat.

An example of a Kubierschky-type process is disclosed in United States Patent No. 3,959,450 ("Calloue").

B. Pre-Chlorination

"Pre-Chlorination" refers to reacting chlorine gas with brine even before the brine enters the top of the tower.

The Bromine Tower Patents

These patents are two in a series of three patents claiming inventions for a continuous process for recovering bromine from bromide-containing brine under vacuum. The first patent (the parent) was filed on June 19, 1984, and ultimately was issued on February 16, 1988, as U.S. Patent No. 4,725,425 (the "'425 patent").FN3. On June 20, 1985, some three years before its parent application was issued, Albemarle filed a second patent application as a continuation-in-part of the application for the ' 425 patent. This second patent basically added a second stage enclosed chamber to the vacuum bromine tower invention claimed in the '425 parent. On January 12, 1988, this second patent was issued as U.S. Patent No. 4,179,096 (the "'096 patent").FN4 And finally, on July 21, 1987, Albemarle filed a third application as a continuation-in-part of the ' 425 patent. This patent, U.S. Patent No. 4,978,518 (the "'518 patent"),FN5 issued on December 18, 1990, again concerning the same general process as that of the parent application.

FN3. JA-0225-JA-0229.
FN4. JA-0001-JA-0008.
FN5. JA-0463-JA-0467.

Thus the court has before it a parent and two siblings, each containing common claim terms which must be construed consistently across the asserted claims. The circuitous path to consistency in this family of patents begins with the disputed claims in the two patents at issue, keeping in mind that these claims derive from a common ancestor, the '425 patent. The disputed terms are in bold.

The '096 Patent

Albemarle asserts claim 1 of the '096 patent, which reads, with the disputed terms underlined and bolded, as follows:

A continuous process for recovering elemental bromine from a ***bromide-containing brine,*** said process comprising:

(a) continuously introducing said Bromide-containing brine into the upper portion of a ***first stage enclosed chamber,*** said first stage enclosed chamber being an upright ***fiberglass-reinforced plastic tower;***

(b) continuously introducing chlorine and recovered steam, recovered bromine and recovered chlorine into the lower portion of said first stage enclosed chamber whereby said chlorine contacts said bromide-containing brine in a Stripping zone in a counter current manner;

(c) continuously removing gaseous bromine, chlorine and water from the top of said first stage enclosed chamber;

(d) maintaining a subatmospheric pressure within said first stage enclosed chamber said subatmospheric pressure being in the range of from about 6 to about 12 psia;

(e) continuously removing tail brine from the bottom of said first stage enclosed chamber;

(f) continuously introducing said ***tail brine*** into a ***second stage enclosed chamber;***

(g) maintaining a subatmospheric pressure within said second stage enclosed chamber sufficiently low to cause boiling of said tail brine;

(h) continuously recovering additional steam, chlorine and bromine not recovered in said stripping section of said first stage enclosed chamber from said second stage enclosed chamber by maintaining a pressure in said second stage enclosed chamber that is less than the vapor pressure of said tail brine in said second stage enclosed chamber; and

(i) continuously introducing the recovered steam, chlorine and bromine from said second stage enclosed chamber into the bottom of said first stage enclosed chamber.FN6

FN6. JA-0008.

The '518 patent

Albemarle also asserts Claim 1 of the '518 patent, with the disputed terms underlined and bolded, as follows:

A continuous process for recovering elemental bromine from ***bromide-containing brine*** said process comprising:

(a) continuously introducing said bromide-containing brine into the upper portion of an ***enclosed chamber;***

(b) continuously introducing chlorine and steam into the lower portion of said chamber whereby said chlorine contacts said bromide-containing brine in a counter current manner;

(c) continuously removing gaseous bromine and water from the top of said chamber;

(d) continuously removing bromide-depleted brine from the bottom of said chamber; and

(e) maintaining a sub-atmospheric pressure within said chamber.FN7

FN7. JA-0467.

Discussion of the Terms in Dispute in the '096 and '518 Bromine Tower Patents

1. bromide-containing brine

This term appears in claim 1 of the '096 patent and claim 1 of the '518 patent. It first appeared, however, in the parent of these two sibling patents, the '425 patent. The claim (in all three patents) reads as follows:

A continuous process for recovering elemental bromine from a ***bromide-containing brine,*** said process comprising: FN8

FN8. JA-0008; JA-0229; JA-0467.

The parties agree that the term should have the same meaning throughout the three patents. Albemarle contends that "bromide-containing brine" means "an aqueous (water) solution that contains a bromide." Great Lakes argues that the term means "brine having levels of bromide of at least 2000 ppm, without a prechlorination step." In other words, Great Lakes argues for a minimum concentration of bromide to brine, i.e., 2000 ppm, without any prior prechlorination treatment, whereas Albemarle contends that prechlorination is not prohibited and that there is no minimum concentration of bromide required.

Tracing the use of the disputed claim term through the patent history and its use in the patents themselves is torturous at best, but the journey begins, for purposes of this discussion, with the parent of '096 and '518, the '425 patent. The process of recovering bromide from brine was not new, even in 1984 when Albemarle's predecessor (the patentee will be referred to as Albemarle for simplicity) first applied for the patent, and for the next four years, the applicant struggled to convince the Examiner that this patent could be distinguished from prior art. The '425 patent initially called for the use of "bromide-rich" brine rather than "bromide-containing" brine, but this term was rejected by the Examiner as indefinite as to degree. Albemarle argued that the term was not indefinite because it had stated in the specifications that bromide-rich brine meant 2000-6000 ppm bromide. Albemarle further attempted to distinguish its definition from one well known in the industry for bromide-rich brine, which is 1000 ppm or more bromide, by insisting that the term "bromide-rich" encompasses its definition: "[R]aw brine *relatively* rich in bromide is defined as 0.1% [1000 ppm] or more" and '[t]he disclosure in Applicants' specification,,, of 2000-6000 parts per million is well within the category of more than 0.1% or more." FN9 In other words, a bromide level of 2000-6000 ppm was easily within the parameters of a "bromide-rich brine" because the concentration is greater than 1000 ppm of bromide to brine. When Albemarle failed to convince the Examiner of its position, it changed the term in the first claim from "bromide-rich brine" to "bromide-containing brine," stating that it had "no real effect on the claims" and was "made to simplify the issues." FN10 Albemarle then added a dependent claim in the '425 invention making it clear that the bromide containing brine in that invention had a specific concentration of bromide of 2000-6000 ppm.

FN9. JA-0289.

FN10. JA-0290.

Although Albemarle acquiesced to the Examiner and changed the term "bromide-rich" to "bromide-containing" in the claims themselves, Albemarle hardly ceased using the term "bromide-rich" throughout the specifications of the entire family of patents. In the very next patent, filed about a year after the parent was filed, the '096 patent specifically set out the definition of "bromide-rich brine" in that part of the specification entitled the "Detailed Description of the Preferred Embodiments," where it "is defined as one containing .1 percent bromide." FN11 The specification goes on to state that "a brine with bromide in the range of 2000 to 6000 or more parts per million is preferred." FN12 Thus, in both the '425 prosecution history and in the '096 specifications, Albemarle has consistently defined a "bromide-rich brine" as brine having at least 1000 ppm bromide.

FN11. JA-0004.
FN12. JA-0005.

In the '518 patent (filed four years after its parent, the '425, and three years after its sibling, the '096), the term "bromide-rich" is not specifically defined in the specifications as brine having at least 1000 ppm bromide, but "bromide-rich" is the only phrase used to describe the feed brine outside of the preferred embodiments section until claim 1, when "bromide-containing brine" is used for the first time. The Abstract reads, "A continuous process for the extraction of bromine from a bromide-rich brine...." FN13 The Background of the Invention reads, "The present invention relates to a highly efficient continuous process for the extraction of bromine whereby chlorine is contacted with bromide-rich brine...." FN14 It is only when we reach claim 1 that the term "bromide-containing brine" suddenly appears.

FN13. JA-0463.
FN14. JA-0465.

Interestingly, both the '425 and '518 patents not only restrict themselves to the use of the term "bromide-rich" throughout the specifications, but also they contain identical, word-for-word recitals in the Detailed Description of the Preferred Embodiments section concerning brine and bromide:

Brine is an aqueous solution which is nearly saturated with halide salts. For the purposes of the present invention alternative terminology would include an aqueous solution of a bromide. Bromine may also be produced from hydrobromic acid by the process of the present invention.

Brine is produced in several areas of the United States. Brine typically may contain natural gas, crude oil, hydrogen sulfide, sodium chloride, sodium bromide and other salts. The amount of sodium bromide present in the brine depends on the individual formation. However, for the purposes of the present invention, it is generally estimated that there is approximately 2000-6000 parts per million of sodium bromide in brine.FN15

FN15. JA-0227; JA-0465.

It is only in the '096 specifications that the above recital changes, and it is from this single variation that Albemarle picks its construction of the term "bromide-containing brine":

Bromide-containing brine [as opposed to just "brine" in the '425 and '518] is an aqueous solution which is nearly saturated with halide salts. For the purposes of the present invention alternative terminology would include an aqueous solution of a bromide. Bromine may also be produced from hydrobromic acid by the process of the present invention.

Brine is produced in several areas of the United States. Brine typically may contain natural gas, crude oil, hydrogen sulfide, sodium chloride, sodium bromide and other salts. The amount of sodium bromide present in the brine depends on the individual formation. For purposes of the present invention, a brine composition containing sufficient sodium bromide to economically warrant the removal of bromine therefrom is referred to herein as a "bromide-containing" brine.FN16

FN16. JA-0004.

The specification continues as follows:

Preferably the bromide-containing brine feed sources from which the bromine is extracted should be a bromide-rich brine. The latter is defined as one containing 0.1 percent bromide. A brine with bromide in the range of 2000 to 6000 or more parts per million is preferred.

Typical suitable bromine-containing brines have about 3000-5000 parts per million bromide.FN17

FN17. JA-0004-JA-0005.
The '096, unlike the '518 and its parent, the '425, uses the term "bromide-containing brine" rather than "bromide-rich brine" in the Abstract, Description of Prior Art, and Summary of the Invention. In the Detailed Description of the Preferred Embodiments, the language changes, for example:

A highly energy efficient and improved continuous process for recovering elemental bromine from *a bromide-containing or bromide-rich brine* .... continuously introducing said *bromide-containing or bromide-rich brine* ... said chlorine contacts said *bromide-containing or bromide-rich* ... the *bromide-containing brine* is first treated ... cooled *bromide-rich feed brine* is introduced ... the vapor pressure of the *bromide-rich feed brine* ... recovering bromine from a *bromide-containing or bromide-rich feed brine*." FN18 (Emphasis added).

FN18. JA-0004.
As stated previously, Albemarle contends that that bromide-containing brine is simply an aqueous (water) solution of a bromide, which is the definition of brine-not bromide-containing brine-in both the '425 and '518 patents. Albemarle argues that there is no required upper or lower concentration of bromide to brine in the claim. Concentrations will vary, and under Albemarle's construction of the claim, *a* bromide molecule in an aqueous solution would satisfy the claim.

The court, however, must look to the entirety of the patent and its family to make sense of it. The first stumbling block for Albemarle lies in the process of the invention itself. The '096 patent calls for a two stage process whereby bromine is captured from bromide, which is found in brine. The first stage strips bromine from bromide, but not all of it. The bromide-depleted brine or tail brine is further treated to remove more bromine. The specifications teach that tail brine "typically contains almost 50 to about 200 parts per million bromide." FN19 The point is not exactly how much bromide remains after the first stage of the process, but rather that the invention clearly anticipates a concentration of something more than one or two molecules of bromide in the initial feed brine. If some degree of residual bromide remains in the brine after the first stage of the process, then the total concentration of bromide in the feed brine (the bromide-containing brine) must be greater than the concentration of bromide in the tail brine; i.e., more than a bromide molecule.

FN19. JA-0005.
On the other hand, Great Lake's insistence on a lower limit of 2000 ppm bromide runs into trouble quickly, also. All three patents note that the concentration of bromide will vary according to the formation from which the brine is taken. Both the '425 and the '518 patents consistently refer to the feed brine as bromide-rich brine throughout the entirety of the specifications. Both the '425 and the '518 patents in the Detailed Description of the Preferred Embodiments state that "it is generally estimated that there is approximately 2000-6000 parts per million of sodium bromide in brine." FN20 Thus there are two descriptions of the "bromide-containing brine" in these two patents: one is "bromide-rich brine"; the other is "approximately 2000-6000 ppm.of bromide." In both patents, the Abstract calls for "bromide-rich brine"; the summary of the invention calls for "bromide-rich brine"; the Detailed Description of the Preferred Embodiments, however, calls for not only a bromide-rich brine but a particular bromide-rich brine, one with a lower limitation of 2000 ppm. To construe the claim as having 2000 ppm as its lower limit would completely write out of the specifications the repeatedly consistent description of the feed brine as "bromide-rich brine," which has just as consistently been defined as one having bromide in concentrations of 1000 ppm or more. Additionally, and as noted earlier, the ' 425 patent, with its identical language in the specifications, actually has a dependent claim setting forth the 2000-6000 ppm concentration. If bromide-containing brine meant 2000-6000 ppm, there would be no need for the dependent claim. Bromide-containing brine makes sense in the context of the entirety of the patent history and specifications of the '425 and the ' 518 patents only if it

means a brine having the same concentration as a bromide-rich brine having concentrations of bromide of 1000 ppm or more.

FN20. JA-0227; JA-0465.

The last question is whether this analysis is consistent with the '096 patent, because the claim terms must be construed consistently across the related patents. The '096 patent first uses the definitions of *brine* used in the '425 and '518 patents to describe *bromide-containing* brine, but the specification does not stop there. It adds that the bromide concentration be sufficient to "economically warrant" removal of bromine.FN21

FN21. JA-0004.

There must be, then, some concentration of brine beyond *a* bromide molecule necessary for the invention to function as intended. The specification next states that it "prefers" bromide-rich brine, which it defines as 1000 ppm, but prefers even more the ever repeated 2000-6000 ppm concentration of bromide. It further teaches that typical brines have bromide concentrations from 3000-5000 ppm. A preferred embodiment generally cannot be used to limit a claim. On the other hand, simply putting the word "preferred" in front of a phrase does not automatically convert it to a limitation or a preferred embodiment. The claims must be read in light of the entirety of the related applications, the patent history and the specifications.

During the prosecution history of the '425 patent, Albemarle made it clear that its invention provided economic benefits for recovering bromine from a bromide-rich brine. It also indicated that changing the claim term "bromide-rich" to "bromide-containing" made no real difference to the claims. The invention still used a feed brine that fell within the parameters of a bromide-rich feed brine. Throughout the Detailed Description of the Preferred Embodiments, the '096 patent language uses the phrase "bromide-containing or bromide rich brine." Viewed in isolation and without context, the phrase "bromide-containing or bromide-rich brine" theoretically could be a choice between different things, but in viewing the patent as a whole, including the family of patents, the meaning of the phrase "bromide-containing or bromide-rich" is consistent only if the terms are in fact synonymous. It is akin to saying the level of bromide in the brine is "0.1 percent or 1000 ppm." Only then do Albemarle's explanations and arguments in the prosecution histories, inventions, and specifications of the related patents work together with a claim construction that is consistent and not contradictory with either the use and process of the invention itself, its preferred embodiments, its descriptions, the entirety of the specifications, or Albemarle's own definitions of bromide-rich brine, which no one denies would be known and accepted by a person skilled in the art.

But Great Lakes further argues that bromide-containing brine must be construed to prohibit a prechlorination step. A prechlorination step is not mentioned in the claims, and the specifications do not expressly mention a prechlorination step in reference to the present invention. However, the 096 patent specification references a prior art that uses a prechlorination step, as follows:

U.S. Pat. No. 3,959,450 discloses a process for producing pure bromine from aqueous hydrobromic acid solutions. A bromide containing mother liquor or sea water concentrate is treated with chlorine to produce pure liquid bromine and bromine dissolved in a liquor portion. The former is separated from the latter and the latter is steam distilled in the presence of chlorine. Crude liquid bromine containing chlorine as an impurity is condensed. The crude liquid bromine is washed and pure liquid bromine separated therefrom and collected.FN22

FN22. JA-0003.

The '096 and '518 patent specifications both teach that "[b]romine may also be produced from hydrobromic acid by the process of the present invention." FN23

FN23. JA-0004; JA-0465.

While the specification does not directly discuss prechlorination, the invention encompassed the production of bromine from hydrobromic acid, which at least in prior art, included treatment with chlorine prior to any steam treatment. Although Albemarle was distinguishing prior art from the present invention when it discussed the '450 patent discussed above, and obviously the use of brine solution containing crude liquid bromine and not bromide would not fall within the parameters of bromide-containing brine, there is no indication that using hydrobromic acid, as long as the brine solution also has a concentration of 1000 or more ppm bromide, would not fall within the claim parameters. The inventions also envisioned prior treatment of the bromide-containing brine to remove "natural gas, crude oil, and hydrogen sulfide prior to introduction into the contact tower." FN24 There is no indication that the term 'bromide-containing brine" was intended to limit the claims of the invention by either requiring, forbidding, or precluding a prechlorination step. Other than requiring a feed brine with at least 1000 ppm bromide, it is silent.

FN24. JA-0005.

Therefore, the court defines "bromide-containing brine" in claim 1 of the '096 patent and claim 1 of the '518 patent as "brine containing 0.1 percent (1000 ppm) or more of bromide."

2. first stage enclosed chamber

This term appears in claim 1 of the '096 patent:

a) continuously introducing said Bromide-containing brine into the upper portion of a ***first stage enclosed chamber,*** said first stage enclosed chamber being an upright ***fiberglass-reinforced plastic tower;*** FN25

FN25. JA-0008.

Albemarle defines "first stage enclosed chamber" as "a closed space in which entry to and exit from the space is through controlled points only, such as through feed or withdraw openings," and Great Lakes as "an independent, contained vessel into which bromide-containing brine is introduced, prior to introduction into the second stage enclosed chamber." Albemarle makes no distinction among the disputed claim terms "first stage enclosed chamber," "second stage enclosed chamber," or "enclosed chamber."

The term "first-stage" implies some further secondary stage, and the claim language describes a process beginning with the continuous introduction of bromide-containing brine into the upper portion of a first-stage chamber, where it is treated under vacuum to capture bromine from the bromide in the brine. The capture of the bromine from the bromide results in a reduced concentration of bromide, and what is left is tail brine, which exits at the bottom of the first stage enclosed chamber and then enters the second stage enclosed chamber. This process is a continuous one; that is, once begun and underway, the feed brine is continuously added to the upper portion of the first stage enclosed chamber and the tail brine continuously exits at the bottom of the first stage enclosed chamber.

As to "enclosed," the specification of '096 contemplates the entry and exit of materials through controlled points into and out of the enclosed chamber, for example:

Brine conduit 12 enters the space between rectification zone 2 and reaction zone 5 is adapted to distribute feed brine uniformly across the top of retainer 6.

Chlorine feed conduit 13 enters chamber 1 into the space between reaction zone 5 and stripping zone 9. Multiple chlorine feed points are provided to obtain uniform chlorine distribution across the entire chamber cross-section.

Stripping steam is fed through steam conduit 14 to steam nozzles (not shown) which distribute steam across the entire cross-section.

At the top of chamber 1 above rectification zone 2 is suction conduit 15 which connects through condenser 16 and condensate conduit 17 to separator 18 in which bromine separates from an aqueous phase which will be explained hereinafter.

Tail brine conduit 30 connects the bottom of chamber 1 to an elongated upright enclosed chamber 31 designated as Stage 2.FN26

FN26. JA-0006.

Finally, the term "chamber" requires an interpretation more specific than "space." The specification itself uses the word "chamber" interchangeably with the words "tower" and "vessel." For example, the description of the first-stage enclosed chamber is as follows: "The apparatus used to conduct the process comprises an upright elongated substantially cylindrical enclosed chamber 1 designated Stage 1 which functions as the contact tower." FN27 And, the description of the second-stage enclosed chamber is "[t]ail brine conduit 30 connects the bottom of chamber 1 to an elongated upright enclosed chamber 31 designated as Stage 2." FN28 The Stage 2 "chamber" is described as a "vessel," as follows: "This system comprises a vessel designed for a subatmospheric pressure and constructed of suitable materials to be installed on the bromide-depleted brine outlet from the steaming out tower." FN29 Something that has the capacity to have a particular shape (e.g., elongated, cylindrical), position (upright), and has a top and a bottom is more than "a closed space."

FN27. JA-0006.

FN28. JA-0006.

FN29. JA-0005.

Albemarle's proposed definition of "first stage enclosed chamber" as "a closed space" therefore is too broad, and Great Lakes' definition as "an independent, contained vessel" is too narrow and suggestive of two outwardly visible separate vessels, such as those located some distance apart. There is nothing to prohibit such an arrangement, but also there is nothing to demand it.

Therefore, the court defines "first stage enclosed chamber" as "a closed vessel in which entry to and exit from the vessel is through controlled points only, and into which bromide-containing brine is continuously introduced and from which tail brine is continuously removed."

3. fiberglass-reinforced plastic tower

This term appears in claim 1 of the '096 patent:

a) continuously introducing said bromide-containing brine into the upper portion of a ***first stage enclosed chamber,*** said first stage enclosed chamber being an upright ***fiberglass-reinforced plastic tower;*** FN30

FN30. JA-0008.

Albemarle defines "fiberglass reinforced plastic tower" as "a tower made of a genus of plastic which includes vinyl ester and polyester that is reinforced by glass fibers," and Great Lakes defines it as "a tower having walls constructed primarily of exposed fiberglass reinforced plastic within the interior of the first stage enclosed chamber." The specification discusses the fiberglass tower as follows:

Conventional towers with brine temperature of 228-230 F. do not lend themselves to the use of fiberglass reinforced plastics, e.g. fiberglass reinforced vinylester and fiberglass reinforced polyester. The present invention with its reduced operating temperature of 180-210 F. permits the use of such materials.FN31

FN31. JA-0004.

The specification also lists an advantage of the tower:

The present invention provides a number of advantages over conventional systems. Amongst which are the following:

* * *

(8) fiberglass tower construction is less costly, provides a variety of shapes, and requires less repair and maintenance than conventional towers. Towers of this invention are stronger, anti-corrosive and leak proof.FN32

FN32. JA-0004.

Further in the specification, the inventor describes towers of the prior art and the present invention, as follows:

Contact towers operated at atmospheric pressure are traditionally made of granite. The granite towers are very sensitive to overpressuring during process upsets which frequently occur during normal tower operation. The overpressuring may result in tower granite breakage or gasket damage and potentially could cause the entire tower to collapse.

The contact tower of the present invention is operated under vacuum and can be constructed of any material which can withstand the vacuum without collapsing and which material is not adversely affected by contact with brine, chlorine and bromine. Such materials as metal alloys, carbon steel lined with acid brick and the like are suitable as materials of construction for steaming out towers operated below atmospheric pressure. Towers of these materials would need to be rated to withstand full vacuum service at temperatures up to 230 F. FN33

FN33. JA-0006.

There is no requirement in the claim or any indication in the specification or prosecution history that the tower be made solely of fiberglass reinforced plastic, nor that the fiberglass reinforced plastic be located at any particular place in or on the tower, as Great Lakes argues. Nor is there any requirement that the plastic be limited to either vinylester or polyester, as these plastics were used in the specification as examples, and not as a limitation. Therefore, the court defines the term "fiberglass-reinforced plastic tower" as "a tower made of a genus of plastic, such as vinyl ester and polyester, that is reinforced by glass fibers."

4. tail brine

This term appears in claim 1 of the '096 patent:

(f) continuously introducing said ***tail brine*** into a ***second stage enclosed chamber;*** FN34

FN34. JA-0008.

Albemarle would have "tail brine" defined as "bromide-containing brine from which the bromide has been substantially removed," and Great Lakes as "brine from which bromide has been substantially removed." The specification itself describes tail brine, as follows:

A bromide-depleted brine or tail brine is defined as the bromide-containing brine from which the bromide has been substantially removed.FN35

FN35. JA-0005.

The court defines the term "tail brine" as it was defined in the specification, as "the bromide-containing brine from which the bromide has been substantially removed."

5. second-stage enclosed chamber

This term appears in claim 1 of the '096 patent:

(f) continuously introducing said ***tail brine*** into a ***second stage enclosed chamber;*** FN36

FN36. JA-0008.
Albemarle defines "second stage enclosed chamber" as it does "first stage enclosed chamber," as "a closed space in which entry to and exit from the space is through controlled points only, such as through feed or withdraw openings." Great Lakes defines this term as "an independent, contained vessel into which the tail brine is introduced after being removed from the first stage enclosed chamber." For the reasons given in the interpretation of the term "first-stage enclosed chamber," Albemarle's proposed definition is too broad, and Great Lakes' is again too narrow, at least as to the "enclosed chamber" portion. The claim language instructs a process of "continuously removing tail brine from the bottom of said first stage enclosed chamber" and "continuously introducing said tail brine into a second stage enclosed chamber," which directs the introduction of tail brine into the second stage enclosed chamber after removal from the first.

Therefore, the court defines "second-stage enclosed chamber" as "a closed vessel in which entry to and exit from the vessel is through controlled points only, and into which the tail brine is introduced after being removed from the first stage enclosed chamber."

6. enclosed chamber

This term appears in claim 1 of the '518 patent:

(a) continuously introducing said bromide-containing brine into the upper portion of an ***enclosed chamber;*** FN37

FN37. JA-0467.
Similar to the first stage and second stage enclosed chamber definitions, Albemarle would have "enclosed chamber" mean "a closed space in which entry to and exit from the space is through controlled points only, such as through feed or withdraw openings," and Great Lakes would have it defined as "an independent, contained vessel." For the reasons given in the court's interpretation of "first stage enclosed chamber" and "second stage enclosed chamber," the court interprets "enclosed chamber" as "a closed vessel in which entry to and exit from the vessel is through controlled points only."

THE FLAME RETARDANT PATENTS

Three patents are associated with the manufacture and use of brominated flame retardants: United States Patent Nos. 5,077,334 (the '334 Patent) FN38, 5,030,778 (the '778 Patent) FN39, 5,008,477 (the '477 Patent) FN40, collectively, "The Flame Retardant Patents." As with the bromine tower patents, the parties submitted a joint tutorial on the background of flame retardant technology, which is reproduced below.

FN38. JA-0791-JA-0798.
FN39. JA-0711-JA-0715.
FN40. JA-0637-JA-0641.

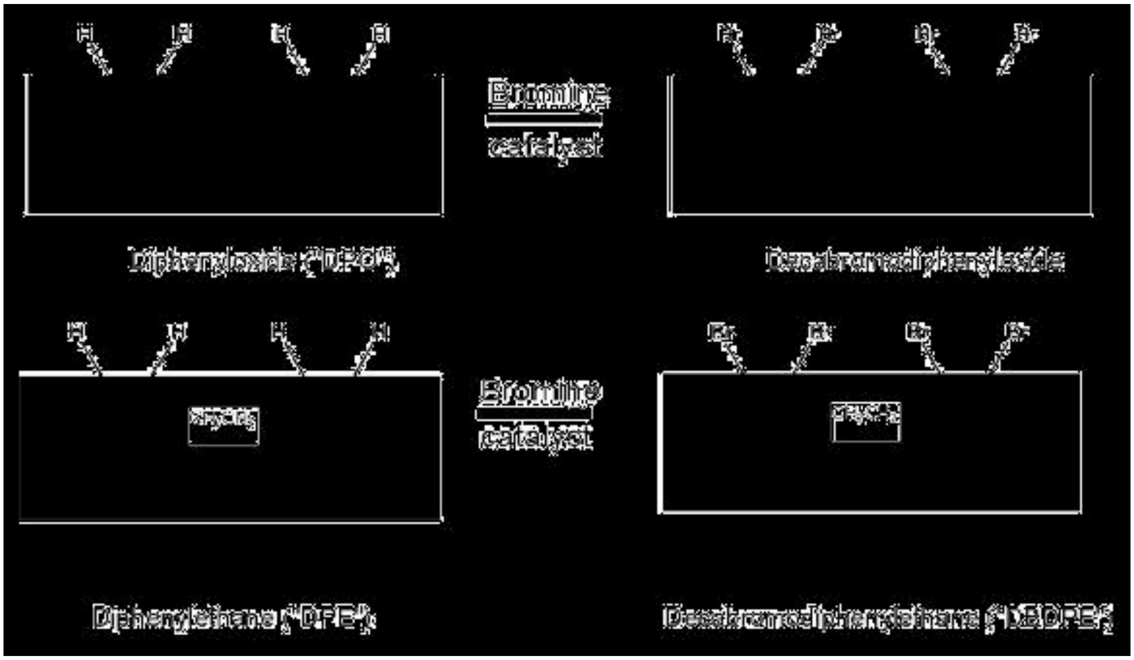
Flame Retardant Technology

Brominated flame retardants are products added to plastics to improve their flame retardancy. Such plastics are used, for example, in computer circuit boards, television housings and wire coatings. Albemarle's '334, '778 and ' 477 patents relate to a brominated flame retardant product called "decabromodiphenylethane" ("DBDPE").

Commercial use of DBDPE as a flame retardant began in the late 1980s after environmental concerns were raised regarding a leading brominated flame retardant product used at the time, decabromodiphenyloxide ("DBDPO") (cf.decabromodiphenylethane). Those environmental concerns centered on the fear that, under certain conditions, decabromodiphenyloxide could form toxins known as dioxins and furans. By contrast, the DBDPE molecule can not form dioxins or furans.

A. Decabromodiphenyloxide vs. Decabromodiphenylethane

The chemical structures for decabromodiphenyloxide, decabromodiphenylethane and the raw materials used to make them are shown below. The products differ in the molecular segment that joins the two phenyl rings (the hexagonal ring-structures). In decabromodiphenyloxide, and in the corresponding raw material used in its preparation, diphenyloxide, an oxygen atom links the two phenyl rings together. The presence of this oxygen atom (oxide) caused the environmental concern over the potential formation of dioxins and furans.



In DBDPE, and the corresponding raw material used in its preparation, diphenylethane ("DPE"), the oxygen atom is replaced with a bridge of two carbon atoms (a.k.a., an aliphatic or an ethyl group) that links the phenyl rings together. Because DBDPE does not contain an oxygen atom, it does not form dioxins or furans.

B. The Preparation of DBDPE

Several approaches can be used to prepare DBDPE. For example, two phenyl rings which already include bromine atoms can be attached to an ethyl bridge to form DBDPE. A well-known method of preparing DBDPE is to add bromine atoms to the DPE molecule.

A white flame retardant product is desirable from a commercial standpoint, because many of the plastic materials in which DBDPE and DBDPO are used are white or light in color. However, regardless of the manufacturing process used, commercial DBDPE products typically contain some level of impurities. Depending on the nature of the impurities and the amount present, impurities can affect the performance and color, and thus the acceptability, of the DBDPE product. Commercial manufacturing processes, therefore, typically include additional steps or equipment to reduce the amount of unwanted impurities found in the DBDPE product.

As shown above, in the preparation of DBDPE, ten hydrogen atoms ("H") on the phenyl rings of each DPE molecule are replaced with ten bromine atoms ("Br"). Thus, a minimum 10:1 ratio of bromine-to-DPE is required to produce DBDPE. FN41 Typically, however, a bromine-to-DPE ratio higher than 10:1 is used in manufacturing DBDPE, to ensure that an excess amount of bromine is present. Because the bromine is a liquid, this excess bromine also serves as a solvent for the solid DBDPE product.

FN41. Technically, the ratio of bromine to DPE is a "mole ratio." A mole is a measure of the amount of a chemical. A mole ratio identifies how many molecules (the amount) of each chemical are present. The parties agree that references to the ratio of ingredients in the patents refers to the mole ratio of bromine to DPE

While the parties and the documents produced in this case typically have referred to such ratios in terms of bromine-to-DPE (*e.g.,* a 25:1 ratio, meaning 25 moles of bromine are present for each one mole of DPE), Albemarle's '778 patent speaks in terms of the ratio of DPE-to-bromine (the inverse). While there is no mathematical difference between describing the ratio in these two different ways, it is tedious having to constantly switch between the two. Thus, the parties have agreed to treat the '778 claim element that refers to a ratio of " ***about*** *0.055 to* ***about*** *0.033 moles of DPE per mole of bromine* " (a term that must be construed by the Court), as its inverse, namely ***about*** *18 to* ***about*** *30 moles of bromine per mole of DPE*. In this way, the documents and argument can consistently be applied to the '778 patent claims.

The formation of a DBDPE product is not an instantaneous reaction. Typically, the reaction is carried out by first adding ("charging") bromine and a catalyst FN42 to a large vessel (a reactor). The contents of the reactor are heated and DPE is added over a period of time. As the DBDPE forms, heat is generated, together with a gaseous byproduct known as hydrogen bromide (HBr). As the reaction proceeds the heat causes some of the bromine within the reactor to boil and form bromine gas. The bromine gas and the HBr gas exit the top of the reactor and enter a heat exchanger (essentially a very efficiently cooled pipe). The bromine gas is cooled and condenses back into liquid bromine within the heat exchanger and is returned to the reactor. The HBr gas does not condense so it passes through the heat exchanger and out of the system.

FN42. A catalyst is a chemical that induces or increases the speed of a chemical reaction, but is not consumed. In the production of DBDPE, may compounds are capable of acting as a catalyst, with aluminum chloride the most commonly used catalyst

After the bromination reaction is complete, the reactor contains a solution which includes the DBDPE product, excess liquid bromine, the bromination catalyst and trace impurities. The DBDPE product, now a solid, is isolated, dried, and further processed to remove impurities, if desired.

C. Yellowness Index (ASTM E323)

The "Yellowness Index" of a material is a numerical measure of that material's color: the lower the Yellowness Index number, the whiter the material.

ASTM is an acronym for the American Society of Testing and Materials (now called ASTM International). ASTM is a voluntary standards organization and a source for consensus on technical standards for a variety of materials, products, systems, and services. ASTM publishes several standard methods for determining the Yellowness Index of a material, one of which is referred to as the ASTM E313 method. The parties agree that the reference to E323 in claim 18 of Albemarle's '477 patent was a typographical error and should be E313.

The Flame Retardant Patents

The flame retardant patents are not related to each other, as the bromine tower patents were, except that they all involve flame retardants. These three patents are associated with the manufacture and use of certain brominated flame retardants, which is called decabromodiphenylethane ("DBDPE"). Two of the patents, the

'334 and '728 patents, contain terms whose interpretation involves determining whether the claim is limited to a particular process described in their specifications.

The '334 Patent

Albemarle asserts claims 1-4 of the '334 patent against Great Lakes. Claim 1 is the only independent claim, and reads as follows:

Claim 1. A thermoplastic formulation comprising:

(a) a flammable macromolecular material; and

(b) a flame retardant amount of a decabromodiphenylethane product containing a predominate amount of decabromodiphenylethane and a lesser amount of impurities, said decabromodiphenylethane being ***produced by the bromination of diphenylethane,*** and said decabromodiphenylethane product being ***oven-aged*** and thereafter having a melting point within the range of from about 344 C to about 355 C.FN43

FN43. JA-0797.

Discussion of Terms in Dispute in the '334 Patent

7. produced by the bromination of diphenylethane

Albemarle argues that this term should be broadly defined as "the DBDPE product is the result of the reaction between bromine and diphenylethane, i.e., a bromination reaction." That is, Albemarle argues that the claim is broad enough to cover the DBDPE product itself, divorced from any particular process other than, generally, a reaction between bromine and diphenylethane. Great Lakes argues that the term should be defined as "a process for brominating diphenylethane in which a solution containing methylene bromide and diphenylethane is fed to a reaction vessel containing elemental bromine and a bromine catalyst." Great Lakes argues that the inventor limited the claim to the DBDPE product produced by the process described in the specification, which process includes feeding a solution of methylene bromide and diphenylethane to a reaction vessel containing elemental bromine and a bromine catalyst.

The prosecution history of the '334 patent includes its grandparent and parent applications, '728 and '952, in which Albemarle attempted to patent process claims (for making the product), product-by-process claims (specifically defining the product by reference to the process claims), product claims (identical to Claim 1 of the '334 patent), and formulation claims. However, Albemarle argues that the product and formulation claims presented in these applications (which became Claim 1 in the '334 patent) were voluntarily withdrawn by Albemarle in the '728 and '952 applications. Therefore, Albemarle argues, its representations to the patent examiner in the prosecution of the '728 and '952 patents do not apply to the '334 patent-or at least they apply only in a negative sense to show that statements made to the examiner do not apply to the product claim in '334. In other words, the examiner did not link the '334 product and formulation claims to the '728 and ' 952 claims for process and product-by-process claims, and the '334 product and formulation claims "stand alone," with Claim 1 as a pure product claim, unlimited by any particular process. Thus, the terms "produced by the bromination of diphenylethane" are meant generically and are not defined by the bromination process set out in the specifications. Albemarle contends that the specifications of the '728 and '952 applications were merely carried over to the '334 application, since the '334 was a divisional application, and therefore the specifications bear no particular import on the '334 patent.

A review of the patent prosecution history and claim language shows that Claim 10 of the '728 and '952 applications, which is virtually identical to disputed Claim 1 in the '334 patent, was prosecuted as a product claim in the '728 and '952 patents. Although Albemarle argues as though all the inventions are unrelated because they carry different names, stripped from the formal nomenclature of "product" or "product-by-process" or "process" or "formulation," the substance of the claims involves various permutations of a particular process which results in a product that can be used in formulations with other materials as a fire retardant. The process teaches a method of making a high purity DBDPE product using methylene bromide. The product-by-process claim describes the high purity DBDPE product produced by the process set out in the claims, and the formulation claims involve using the high purity DBDPE product in a thermoplastic formulation. The DBDPE product (used in the sense of the "thing" produced) has the same characteristics of melting point and weight loss profile regardless of whether it is part of the product-by-process claims or the formulation claims. The product (the thing produced), regardless of the patent or claim number or name used (product-by-process or just product) is made by the bromination of diphenylethane. Therefore, representations made to the patent examiner in the prosecution of the '728 and '952 patents are relevant to the interpretation of Claim 1 of the '334 patent, which was Claim 10 in the prior applications. The path to the '334 patent is not a straight one, however.

Generally, the history leading up to the '334 patent is one of failed attempts to convince the various Examiners that the ultimate product claimed was unique, whether this product was contained in a conventional "product-by-process" claim or in a conventional "product" claim. Albemarle fought the battle by attempting to patent process claims, then claims of the product made by the specific process (conventional product-by-process claims) and then separate product claims (written as the claim in the instant matter). The examiner rejected the claims again and again. Albemarle correctly argues that much of its argument to the Examiner related to what it described as its unique process for making the resultant product. Albemarle tried repeatedly to distinguish its process from prior art, through, *inter alia,* reference to the use of methylene bromide in its bromination of the diphenylethane. The patent examiner just as often rejected the claims. In particular, the Examiner pointed out that the product itself had to be unique, apart from the process used to make it. The connection between the process and the product, however, was constantly blurred. In its argument to the patent examiner following initial rejection, Albemarle argued that claim 10 of the '728 application was:

... a decabromodiphenylethane product which is predominant in decabromodiphenylethane and which contains a lesser amount of impurities. Claim 10 refers to a product having a high and narrow melting point range ... The Examiner has now [sic] shown, nor do the references teach that such decabromodiphenylethane predominant products are obtainable **much less any processes for obtaining such products.**FN44 (Emphasis added).

FN44. JA-0910.

The examiner again rejected the '728 application, stating that claim 10 was obvious.FN45 Albemarle then abandoned the application.

FN45. JA-1002, 1003.

Albemarle tried again in application number 952. In application number 952, Albemarle again presented the process claims, conventional product-by-process claims, the product claims, including claim 10, and the formulation claims, as presented in the '728 application. Again, the application was rejected. Albemarle withdrew the formulation claims, claims 13-21; but claims 7-12 (which included claim 10) were again rejected as anticipated or obvious under the prior art.FN46 After appeal, however, this new patent examiner stated that while claims 10-12 (the product claims) would remain rejected, if Albemarle would drop claims 10-12 and the withdrawn claims 13-21 from its application, claims 1-9, (the process and product by that process) would be allowable.FN47 The examiner reiterated that "the product claims 10-12, **which are not dependent on the claim 2 process** are still rejected." FN48 (Emphasis added). In other words, the examiner refused to allow Claim 10 as a product apart from a process, which is a different position from the first examiner on the '728 patent. This examiner viewed the process as unique and patentable, and the product, *as long as it is made by that process,* likewise unique and patentable. The examiner went on to explain as follows:

FN46. JA-1245-1251.

FN47. JA-1277.
FN48. JA-1277.
The fact is that decabromo-diphenyl ethane is known. See e.g. Giles at col. 3 line 651. Although the product composition made by the process of claim 19 and claim 2 etc., has been shown to be different from a product made by the Mitchell technique, the claims read on decabromobiphenyl ethane *per se,* so, they relate to a product which is already in the possession of the public.
If Applicant were to cancel the non-elected claims 13-21 and also claims 10-12, this case would appear to be in condition for allowance.FN49

FN49. JA-1278.
Albemarle proceeded to withdraw claims 13-21 and claim 10 -12 in anticipation of the allowability of claims 1-9, the process and product by process claims in the '952. Albemarle apparently submitted the withdrawn claims again as the '818 application, which became the '334 patent. This 818 application was initially rejected. After rejection, Albemarle argued to the patent examiner that the "Parent application Serial No. 07/387,952 **contains allowed claims to the decabromodiphenylethane product having the characteristics set forth in claims 22, 26 and 30 hereof.**" FN50 (Emphasis added). The patent office, however, changed its mind regarding the '952 application, and again rejected the process and product by process claims 1-9. In their rejection of the process and product by process claims of the '952, the patent examiner reversed its position and repeated its earlier rationale; that is, that the product (which is the same product as claim 1 in '334) was not unique standing alone:

FN50. JA-1431.
... these claims are unpatentable for the reasons given in the previous rejection of these claims in the present application and parent Application Serial No. 07/205,728 since these claims are suggested by the [sic] decabromodiphenyl claims may have limitations defined by the process for manufacturing the product, determination of patentability is based upon the product itself. Compare IN RE THORPE, 777 F.2d 695, 227 USPQ 964.FN51
FN51. JA-1301-1302.
There is no indication in the record that the process and product by process claims as presented in Claims 1-9 of the '728 and '952 applications were ever pursued again. Instead, as stated above, Claim 10 of the '728 and '952 applications, which was uniformly rejected as an existing product already known, became part of Claim 1 of the '334 patent. In other words, the DBDPE product never stood alone, per se, without a process, and was not represented to the '818 ('334) application examiner as standing alone, but instead as a product which had process and product by process claims allowed to it in the ' 952 application. The only favorable finding by an examiner throughout the history of all the applications was the temporary indication of approval of the process and product-by-process based on the rationale that the product was unique only because it was produced by a particular process.

With these series of rejections in hand, the '334 application was presented to the examiner with the same specification of applications '728 and '952, which outlines the particular process used to create the product. The abstract of the '334 patent states as follows:

This invention *relates to a process for preparing a product* which is predominant in decabromodiphenyl alkane. The *process comprises:* forming a stirrable reaction mass by adding a solution containing methylene bromide and diphenylalkane to a reaction vessel containing elemental bromine (Br2) and a bromination catalyst; maintaining the reaction mass for a period of time sufficient to achieve perbromination of substantially all of said diphenylalkane; and recovering from the reaction mass the product which is predominant is decabromodiphenyl alkane.FN52

FN52. JA-0791.
As pointed out by Great Lakes in brief, the specification continually refers to a particular process for producing the product, as generalized above. The specification also includes multiple examples of inferior

products produced by different processes. The specification further states that "[T]he use of methylene bromide as a solvent portion of the feed solution is an important aspect of this invention, as its use gives a superior product." FN53 The specification also states that "Methylene bromide is preferred (as a wash) since it is the same compound used as the solvent in the process." FN54

FN53. JA-0792.
FN54. JA-0792.

The invention does not suggest the use of methylene bromide, but rather requires it as a part of the bromination process. The specification clearly contemplates the use of methylene bromide as a solvent for the diphenylethane feed in the process, along with elemental bromine and a catalyst, to be used in the bromination of the diphenylethane. Throughout the prosecution history of the '334 patent's "grandfather" patent, the '728 patent application, the invention was described as producing a superior product by using the particular process described:

Applicant's claimed process has several unique features which, when taken in combination, provide for the production of a high quality product which is predominant in decabromodiphenylalkane product.

* * *

The process features which enables [sic] the obtainment of such a decabromodiphenylalkane predominant product are as follows. First, the order of the addition requires that a solution of the diphenylalkane reactant and methylene bromide be added to a reaction vessel containing Br2 and a bromination catalyst. Second, the amount of methylene bromide in the added solution comprises 40 to about 90 wt % of the solution....

* * *

While each of these features, when taken individually, may seem ordinary, Applicant has found that their combination produces the before-mentioned unique and high quality decabromodiphenylalkane predominant product.FN55

FN55. JA-0901-JA-0903.

The use of methylene bromide is repeatedly urged as a unique feature of the invention, and the invention is Claim 1 of the '334 patent. Albemarle is correct when it argues that it tried on repeated occasions to obtain a product claim apart from the process used to make it. But there is more to the story. It also repeatedly attempted to obtain a patent for a conventional product-by-process claim, which had exactly the same characteristics of melting point and weight loss profile as the product as in the '334, except that it was defined in terms of the process claims set out in prior claims 1-9. That claim was consistently and repeatedly rejected because the product, standing alone, *apart from the process,* was not unique.FN56 The only time it ever received even a temporary nod of approval was when an Examiner opined that the product, as limited by the process, would be acceptable. Although that optimistic statement was later overruled and the product-by-process claim rejected, the claim that was finally approved in '334 is for a product produced by the bromination of diphenylethane. It is exactly the same product discussed over and over in the prosecution history. The product claim clearly refers to a method of production and is so limited by that method; i.e., produced by the bromination of diphenylethane.

FN56. This confusing history is probably as much a result of the confusing and conflicting state of the law with regard to product by process claims as anything, and the motivations of both the Examiner and the Applicant were probably driven in part by trying to anticipate the impact of that shifting law on their claims.

The question, then, is the meaning of "bromination of diphenylethane." Even Albemarle does not really dispute the emphasis that the specification places on the method of production. Albemarle instead argues to simply disregard the '334 specifications because they were imported wholesale from prior applications seeking both process and product-by-process claims. The claims, however, must be read in light of the specifications, and the public has a right to depend upon what a patentee chooses to put in those specifications. There is nothing in the prosecution history or in the specifications that divorces either from the claims in the '334 patent. The specifications, like the prosecution history, repeatedly distinguish the invention from prior art by reference to the process used to create a DBDPE product with these characteristics; that is, by the bromination of diphenylethane by feeding a solution containing methylene bromide and diphenylethane to a reaction vessel containing elemental bromine (Br2) and a bromination catalyst."

For the reasons given above, the court finds that the term "produced by the bromination of diphenylethane" means "a process for brominating diphenylethane in which a solution containing methylene bromide and diphenylethane is fed to a reaction vessel containing elemental bromine and a bromine catalyst."

8. oven-aged

This term also appears in claim 1 of the '334 patent:

(b) a flame retardant amount of a decabromodiphenylethane product containing a predominate amount of decabromodiphenylethane and a lesser amount of impurities, said decabromodiphenylethane being ***produced by the bromination of diphenylethane,*** and said decabromodiphenylethane product being ***oven-aged*** and thereafter having a melting point within the range of from about 344 (deg.)C to about 355 (deg.)C.FN57

FN57. JA-0797.

Albemarle argues that "oven aged" "means the DBDPE product is exposed to an elevated temperature for a period of time to reduce impurities, such as unreacted bromine." Albemarle argues that restriction of the claim to a specific numerical range appearing in the description would be improper, as there is no indication that the inventor intended to limit the term "oven aged" to any particular time or temperature, but instead simply used the terms as a means to achieve a desired result-a product having a melting point within the range of from about 334 (deg.) C to about 355 (deg.) C. Albemarle cites its experts' reports, which state, *inter alia,* that oven-aging is synonymous with roasting or heat-treating, and is not the same as "drying" which is the removal of gross amounts of liquid.

Great Lakes argues that "oven-aged" means that "the DBDPE product is heated at a temperature in excess of 150 (deg.)C for a period of time of not less than one hour." Great Lakes argues that this construction of the term is what one of ordinary skill in in the art would understand from the specification, and that extrinsic evidence, in the form of its expert Dr. Daniel Scharf, supports an interpretation of oven aging as "a process in which a compound is exposed to an elevated temperature for a period of many hours, often overnight, in order to remove impurities from the compound." FN58

FN58. Defendant Great Lakes Chemical Corporation's Opening Brief on Claim Construction, p. 93, citing Supplemental Expert Report of Dr. Daniel J. Scharf, Exhibit 14, p. 13.

The specification references several combinations of temperature and time, both for examples of product that are "of the invention" and that are "not of the invention." The time ranges for oven aging for products that are "of the invention" range from 8 hours to 18 hours, and the temperatures range from 190 (deg.) C to 200 (deg.) C. The time ranges for oven aging for products that are "not of the invention" range from 3 hours to 18 hours, and the temperatures are all 200 (deg.) C. Therefore, the specification examples, both of and not of the invention, use the term "oven-aging" to describe exposure to temperatures of between 190 (deg.) C and 200 (deg.) C for a period of between 3 hours to 18 hours. The specification's direct reference to "oven-aging" states that "[t]he oven aging generally will occur at a temperature in excess of 150 (deg.) C., but below 275 (deg.) C., for a period of about 4 to about 24 hours." Therefore, the specification's direct reference to "oven aging" does not correlate with the examples given either of the invention, or not of the invention, as the temperatures were much narrower, 190 (deg.) C or 200 (deg.) C, and the time varied from 3 to 18 hours for products "not of the invention" and from 8 to 18 hours for products "of the invention."

The point in reciting all of these examples is to illustrate that there is not a particular time or temperature range defined or absolutely required in the specification. Indeed, even the description of "oven-aging" states non-specifically that it will **generally** occur in a particular time and temperature range. The court agrees with Albemarle that in this case the claim term "oven-aged" should not be limited to a numerical range that appeared in the description and examples. See RF Delaware v. Pacific Keystone Technologies, 326 F.3d 1255 (Fed.Cir.2003). Therefore, the court finds no support for Great Lakes' interpretation of oven-aged to require a temperature in excess of 150 (deg.) C for a period of time of not less than one hour.

In contrast to oven-aging, the specification also teaches a drying step, also with different combinations of temperature and time. The drying step is not included in the claims. The drying step combinations range from temperatures of 100 (deg.) C to 190 (deg.) C and from times of 1 hour to 4 hours. According to the parties' experts, the purpose of drying is to remove gross amounts of liquid from a solid product, while the purpose of oven aging is to remove entrained bromine and other impurities, and to obtain a product having the desired melting point characteristic.FN59 Great Lakes' expert Dr. Daniel Sharf, and Albemarle's expert Carroll Larke also both agree that in oven-aging, a solid product is subjected to and/or maintained at an elevated temperature for a sufficient period of time to obtain a desired result.FN60 Therefore, while Albemarle's proposed definition takes into consideration the reduction of impurities, it does not adequately define the purpose of obtaining a desired result-in this claim, a product with a particular melting point, so as to differentiate between oven-aging and drying, which also occurs at an elevated temperature for a period of time, but whose purpose is simply to remove excess liquid from a solid product. Therefore, the court defines "oven-aging" as the parties experts did, at least in part, as meaning "the DBDPE product is exposed to an elevated temperature for that period of time necessary to reduce impurities, such as unreacted bromine, and to obtain a product having the claimed characteristics."

FN59. Albemarle's Response to GLCC's Opening Brief on the Proper Construction of Disputed Claim Terms in U.S. 5,008,477, 5,030,778.5,077,334 and 5,124,496 (The Flame Retardant Patents), Exhibit I, Albemarle's Expert Reports of Dr. Daniel Klempner, p. 12; Exhibit G, Albemarle's Expert Reports of Carroll Larke, p. 19; Defendant Great Lakes Chemical Corporation's Opening Brief on Claim Construction, p. 93, citing Supplemental Expert Report of Dr. Daniel J. Scharf, Exhibit 14, p. 11.

FN60. Albemarle's Response to GLCC's Opening Brief on the Proper Construction of Disputed Claim Terms in U.S. 5,008,477, 5,030,778.5,077,334 and 5,124,496 (The Flame Retardant Patents), Exhibit G, Albemarle's Expert Report of Carroll Larke, p. 19; Defendant Great Lakes Chemical Corporation's Opening Brief on Claim Construction, p. 93, citing Supplemental Expert Report of Dr. Daniel J. Scharf, Exhibit 14, p. 12.

The '778 Patent

Albemarle asserts claims 1, 2, and 4 of the '778 patent. Claims 2 and 4 are dependent claims which have no additional terms in dispute, so only Claim 1 will be reproduced herein. Claim 1 reads as follows:

Claim 1. A process for preparing a decabromodiphenylalkane, which process comprises:

(a) charging a reaction vessel with a bromination catalyst and liquid elemental bromine;

(b) feeding liquid diphenylalkane to the reaction vessel at a point which is ***beneath the level of the charged liquid bromine,*** the liquid diphenylalkane being fed in an amount which provides from about 0.055 to about 0.033 moles of diphenylalkane per mole of elemental ***bromine initially charged;*** and

(c) maintaining the reaction mass at a temperature within the range of from about 30 (deg.) C to about 80 (deg.) C during the liquid diphenylalkane feed. FN61

FN61. JA-0715.

Discussion of the Terms in Dispute in the '778 Patent

9. beneath the level of the charged liquid bromine

This term appears in claim 1 of the '778 patent, as outlined above. Albemarle argues that the phrase "beneath the level of the charged liquid bromine" means "that the diphenylethane is fed into the reaction vessel while surrounded by the charged liquid bromine." Great Lakes argues that "beneath the level of the charged liquid bromine" means "below the surface of the liquid bromine."

The phrase "beneath the level of" when applied to a contained liquid implies "beneath the surface of," not "surrounded by," Albemarle's arguments regarding the difficulty of discerning the actual surface aside. If the phase meant "surrounded by," there would be no need for the term "beneath," as when something is surrounded by a liquid, it is both beneath, above, to the right, to the left of, and in every discernable spatial relationship to the surrounding liquid. Furthermore, throughout the specifications of the patent, the addition of the liquid diphenylalkane is described as thus:

The addition of the liquid diphenylalkane to the reaction vessel below the liquid level of the bromine is an important feature of the subject process. It has been found that with this sub-surface feed, a reactions product having a high average bromine number is obtained more quickly than is the case when the liquid bromine is fed above the liquid surface of the bromine. The depth below the liquid bromine surface at which the feed is to occur is that depth which is sufficient to diminish or obviate splattering of the reaction mass as the feed is occurring. Generally, a depth of from about 0.5 to about 1.0 inches, for laboratory scale equipment, and from about 6 inches to about 6 feet, for commercial scale equipment is suitable. In almost all cases, a depth of about one-half inch will be functional.FN62

FN62. JA-0712.

Clearly the inventor envisioned a feed below the surface of the liquid, and not any other spatial relationship. Therefore, the court defines the phrase "beneath the level of the charged liquid bromine" as "below the surface of the charged liquid bromine."

10. bromine initially charged

This term likewise appears in Claim 1 of the '778 patent:

1. A process for preparing a decabromodiphenyl alkane, which process comprises:

a) charging a reaction vessel with a bromination catalyst and liquid elemental bromine;

b) feeding liquid diphenylalkane to the reaction vessel at a point which is ***beneath the level of the charged liquid bromine,*** the liquid diphenylalkane being fed in an amount which provides from about 0.055 to about 0.033 moles of diphenylalkane per mole of elemental ***bromine initially charged;*** FN63

FN63. JA-0715.

Albemarle contends that "bromine initially charged" means "the amount of bromine added at the start of the process." Great Lakes contends that it means "bromine that was added to the reaction vessel prior to the completion of the DPE feed to the reaction vessel." In other words, Albemarle wants the ratio of bromine to DPE (which determines the amount of DPE fed into the reactor) measured at the beginning of the process, so that further additions of bromine are immaterial to the ratio. Great Lakes wants the bromine number in the ratio to include further additions of bromine to the reaction vessel; that is, every addition of bromine from the beginning of the process through the completion of the addition of the DPE to the reaction vessel would be counted toward the bromine number in the ratio.

According to the joint tutorial, generally what happens in the process of making a DBDPE product is that bromine and a catalyst are added to a large vessel (the reactor or reaction vessel). DPE is added to the reactor over a period of time. The object of this bromination reaction is to replace ten hydrogen atoms on the phenyl rings of each DPE molecule with ten bromine atoms to obtain a DBDPE product. Thus a 10:1 ratio of bromine-to-DPE is required to produce DBDPE, but generally more than the minimum amount of bromine is used. As the DBDPE is formed during the bromination reaction, heat is generated, together with a gaseous byproduct (hydrogen bromide or HBr). The heat also causes some of the bromine in the reactor to boil, which forms bromine gas. These gases (bromine and HBr) exit the top of the reactor, then go through cooled pipes where the bromine gas condenses back into liquid bromine and is returned to the reactor. The HBr does not condense and exits the system. After the bromination reaction is complete, the reactor contains a solution which contains the DBDPE product along with excess bromine, the catalyst and trace impurities.

While the above generally describes a process for making DBDPE-and one which would be familiar to anyone schooled in the art-the parties here primarily disagree over what amount of bromine added to the reaction vessel is measured for purposes of determining the ratio of bromine to DPE in this patent. They make their arguments in terms of the timing of the addition of bromine to the reaction vessel. Albemarle contends that only that bromine added at the beginning of the process should count toward the ratio of bromine to DPE required by the claims. Great Lakes counters that all bromine added to the reaction vessel from the beginning of the process through the completion of the DPE feed should be counted.

Although both the claims and the specification refer to steps in the process (adding bromine and the catalyst, adding DPE, maintaining a certain temperature), the list of steps in the claims is preceded by the word "comprising" and the steps have no temporal words or terms connecting them (such as "next" or "then" or "thereafter" or "first" or "second"). There are no words suggestive of an absolute limitation of sequence of events, other than there must be enough bromine and catalyst in the reaction vessel before the DPE feed to allow the DPE feed to be added below the surface of the "charged liquid bromine." Thus at least some bromine and catalyst must be in the reactor prior to initiation of the DPE feed.

The specification likewise does not demand a particular timing. The specification teaches that "[t]he bromination catalyst and bromine can be charged to the reaction vessel in any order or together." FN64 As in the explanation from the joint tutorial, the specification teaches that the bromine here provides a dual service: it can serve as both solvent and as the ar-substitution:

FN64. JA-0713.

The amount of elemental bromine charged to the reaction vessel should provide sufficient bromine to effect the degree of bromination sought and to provide an easily stirred reaction mass. After the reaction is complete, the bromine not used in the ar-substitution will be a liquid component of the reaction mass and will continue to serve the before-mentioned purpose of providing a stirrable reaction mass.FN65

FN65. JA-0713.

According to the specification, bromine also can be added with the DPE. In the specification, it is stated that the DPE "is fed to the reaction vessel as a liquid, i.e. in the molten state or as a solute." FN66 When the DPE is fed as a solute, the solvent may be bromine (or other solvents), and the specification goes on to teach that "if the solvent is bromine, the bromine used *can be counted toward the total amount of bromine used by the process*." FN67 The only "counting" referred to in the process is with relation to the ratio of bromine to DPE. If, as Albemarle contends, only that bromine added at the very beginning counts toward establishing the ratio of bromine to DPE (and thus determining the amount of DPE to be added for the bromination reaction), there would be no need to count further additions of bromine. This additional bromine would be irrelevant to the ratio of bromine to DPE required by the claims, which determines the amount of DPE to be added to the reactor. The specification, however, anticipates that bromine may be added at various times and stages during the process of bromination, and that those additions count toward the total amount of bromine used in the bromination process (which in turn is determinative of the total amount of DPE to be added). The specification also teaches that the amount of bromine to DPE required in the claims takes into account that not all of the bromine will be substituted, but rather it will serve as a solvent, also. If those later additions of bromine may be counted toward the ratio used in the process claims, then it would be illogical to measure the bromine added only at the beginning of the process to determine that ratio. There is nothing in the specification, for example, that would prohibit adding a small amount of bromine (at the beginning of the process), then adding a catalyst, then adding more bromine, then adding DPE and more bromine. According to the specification, all of this bromine would "count" as an addition of bromine to the process, which in turn, would determine the amount of DPE to be fed to the reaction vessel, as expressed in a ratio of bromine to DPE.

FN66. JA-0712.
FN67. JA-0712. (Emphasis added).
From everything written in the specification and in the tutorial, the purpose of the bromine is to create the DBDPE product through substitution of bromine atoms for hydrogen atoms, and to act as a solvent during the bromination reaction. The claimed ratio takes that dual purpose into account. But the only bromine additions that are relevant to the ratio are those added to the reaction vessel before the conclusion of the bromination process. Any bromine added back to the reaction vessel as the result of its being recycled (bromine that exits as bromine gas with the Hbr, goes through a heat exchanger, and is returned to the reaction vessel) would not be bromine "initially charged." Likewise, any bromine used after the bromination reaction is complete would not be counted toward the establishment of the ratio of bromine to DPE.

Thus, Albemarle's construction of "bromine initially charged" as "bromine added at the beginning of the process" is too restrictive. Great Lake's proposed definition as "bromine added prior to completion of the DPE feed to the reaction vessel" is closer, but the court finds no authority in the claim or specification that would prohibit the addition of bromine after the completion of the DPE feed to the reaction vessel as long as the bromination reaction process had not ended and as long as the claimed relationship of bromine to DPE is maintained.

Therefore, the court defines "bromine initially charged" as meaning "all bromine added to the reaction vessel prior to the completion of the claimed bromination process, and does not include any bromine recovered from the claimed process and reintroduced into the reaction vessel."

The '477 Patent

Albemarle asserts claim 18 of the '477 patent, which reads as follows, with the disputed terms bolded and underlined:

Claim 18. ***A flame retardant product*** predominant in decabromodiphenyl alkane, having an alkyl group bridging the aromatic rings, having an average bromine number of at least about 9.0 and having a ***Yellowness Index*** (ASTM E 323) between ***about 11.0 and about 18,*** wherein the alkyl group contains 1 to 10 carbon atoms. FN68

FN68. JA-0641.
Discussion of the Terms in Dispute in the '477 Patent

11. a flame retardant product

The dispute between the parties is whether claim 18 is a product claim with process limitations, or whether claim 18 is a separate product claim. Albemarle would have "flame retardant product" self-defined as "a flame retardant product." Great Lakes would have this term defined as including the '477 process; that is, as "a product produced utilizing each of the following crucial process parameters: (1) maintaining molten DPE in a nonoxidizing atmosphere prior to feeding; (2) utilizing bromine containing 10 ppm or less of impurities; (3) utilizing a $Br2:DPE$ ratio of between 17.8:1 and 30.2:1, and (4) maintaining the reaction mass at < 15 C during the DPE feed."

Claims 1 through 17 of the patent are clearly process claims. Claim 1 reads as follows:

A process for preparing a product predominate in decabromodiphenyl alkane, having an alkyl group bridging the aromatic rings, and having an average bromine number of at least 9.0, the process comprising: forming a stirrable reaction mass by feeding molten diphenylalkane to a reaction vessel to which a bromination catalyst and bromine had been previously charged, the molten diphenylalkane being maintained under a non-oxidizing atmosphere prior to the feeding, and the bromine (i) containing about 10 ppm or less impurities and (ii) being charged in an amount which provides from about 18 to about 30 moles of bromine per mole of diphenylalkane fed; maintaining the reaction mass at a temperature which is less than or equal to about 15 C. to about 60 C; and recovering from the reaction mass the decabromodiphenyl alkane predominant product, wherein the alkyl group contains 1 to 10 carbon atoms.FN69

FN69. JA-0641.

That is, Claim 1, the independent process claim, describes the process that Great Lakes would have imposed as a limitation on Claim 18. Claims 3, 11, 13, 14, 15, 16, and 17 are all claim processes related to the product that evolves from Claim 1. For, example, Claim 11 reads "[T]he process of claim 1 wherein the product is recovered by steam stripping the reaction mass to remove non-entrained bromine therefrom." And, Claim 12 reads "[T]he process of claim 11 wherein the recovered product is washed with an aqueous base to neutralize any HBr which may be present." Claim 18 could have, but did not, define itself as flame retardant product made by the process of Claim 1. Instead, Claim 18 defined itself by its qualities as "predominant in decabromodiphenyl alkane, having an alkyl group bridging the aromatic rings, having an average bromine number of at least about 9.0 and having a Yellowness Index (ASTM E 323) between about 11.0 and about 18, wherein the alkyl group contains 1 to 10 carbon atoms."

Therefore, the language of the claims themselves do not give any indication that Claim 18 is limited by the process of Claim 1, as Great Lakes' suggests.

Furthermore, the specification abstract speaks in terms both of a process and of a product of the invention:

This invention relates to a process for preparing a white or at least near white product which is predominant in decabromodiphenyl alkane and which has an average bromine number of at least 9.0.FN70

FN70. JA-0637.

And,

The process of this invention yields a white or near white product which is predominant in decabromodiphenyl alkane and has an average bromine number of at least 9.0.FN71

FN71. JA-0638.

The specification further states that "[t]he decabromodiphenyl alkane predominant product of this invention may be used as a flame retardant in formulation with virtually any flammable material."

The specification discusses the product as "the product of this invention" multiple times, and discusses the product qualities separate and apart from the process used to make the product. For example, "[T]his product is of good color and can be further treated to have superior color. A preferred product is one which contains 95+ weight percent, and most preferable 98+ weight percent, decabromodiphenyl alkane." FN72 And, "[T]he decabromodiphenyl alkane predominant product of this invention may be used as a flame retardant in formulation with virtually any flammable material." FN73 Furthermore, the examples given in the specification all recite both a process and a product, and in the examples that are "of the invention," Examples III, IV, V, and VI, the product is described in its own paragraph, separate from the process description.

FN72. JA-0639.
FN73. JA-0639.
The prosecution history also reflects that the inventor considered the product patentable separate from the process. In his argument to the patent examiner, the applicant stated that "[A]s demonstrated by Applicant, the product and process of this invention is clearly superior to any prior art process or product." FN74 The applicant first distinguished his patent application from the prior art patents, which were apparently all process patents, FN75 and did not include product claims, by distinguishing his process. The applicant then addresses his product claim by arguing that "[T]here is no suggestion nor is there expectation in the prior art cited by the Examiner that one could get a white or near white decabromodiphenyl alkane product having an average bromine number of at least about 9 and having a Yellowness Index between about 11.0 and about 18 absent Applicant's specific teachings." FN76 While this statement could be interpreted as recognizing a process limitation on the product claim, considering that the prior art patents were all process patents, this statement could just as easily be interpreted as emphasizing the absence of such a product in the prior art patents (thus it was neither anticipated nor obvious), and the novel teachings of the applicant.

FN74. JA-0685.
FN75. The application was originally rejected over a British Patent '524, but that patent cannot be located in the materials submitted to the court. However, two other U.S. Patents were submitted and disucessed as cited references, Nagy, '856 and Mitchell, '248. To the best of the court's understanding, these are process patents, as was '524.
FN76. JA-0686.
Therefore, for the reasons stated above, the court finds "a flame retardant product" requires no further interpretation.

12. Yellowness Index

The term "yellowness index" appears in Claim 18 as follows:

Claim 18. ***A flame retardant product*** predominant in decabromodiphenyl alkane, having an alkyl group bridging the aromatic rings, having an average bromine number of at least about 9.0 and having a ***Yellowness Index*** (ASTM E 323) between ***about 11.0 and about 18,*** wherein the alkyl group contains 1 to 10 carbon atoms. FN77

FN77. JA-0641.
Albemarle would have "Yellowness Index" defined as "a property that is determined according to standard and well-accepted procedures, such as the procedure set forth in ASTM Designation E 313," and Great Lakes would have it defined as a "measurement of the yellowness of the flame retardant product, which is determined according to the procedure set forth in ASTM Designation E313, and which measurement must take place after the treatment of the flame retardant product to remove excess bromine has been completed."

A review of the patent specifications indicates that the concern of this invention was to have as near a white product as possible, so that the product could be used in a wide variety of formulations without discoloration occurring:

If the product's color is not white or at least near white, the product will be suitable for use in some formulations, however, the product's use may not be acceptable in formulations calling for a white or light color.FN78

FN78. JA-0638.
The examples given in the specification all measured the yellowness index of "the heated product," "the solid," "the product," "the resultant product," and "the final product." Nowhere in the claim language or specification does the inventor suggest, as Albemarle argued, that the yellowness index of the product be

measured at any point in time other than at the end of whatever process one is using to create the flame retardant product. That is, the yellowness index of the product only matters when the yellowness of the product matters. And, the yellowness of the flame retardant product matters, according to the specification, when it is used in formulations calling for a white or light color.

The claim language itself describes Yellowness Index as ASTM E 323 (although the parties agree that there is a typographical error and ASTM E 323 should be ASTM E 313), and court sees no reason to expand that standard to encompass additional measurements by the use of the phrase "such as," as Albemarle suggests.

Therefore, the court defines "Yellowness Index" as "a measurement of the yellowness of the final flame retardant product prior to its use in formulations, and which is determined according to the procedure set forth in ASTM Designation E313."

13. between about 11.0 and about 18

The term "between about 11.0 and about 18" is also in Claim 18:

Claim 18. ***A flame retardant product*** predominant in decabromodiphenyl alkane, having an alkyl group bridging the aromatic rings, having an average bromine number of at least about 9.0 and having a ***Yellowness Index*** (ASTM E 323) between ***about 11.0 and about 18,*** wherein the alkyl group contains 1 to 10 carbon atoms. FN79

FN79. JA-0641.

Albemarle argues that the term means "between 9.0 and 20," and Great Lakes argues that it means "between 10.95 and 18.4." This term references the measurement of the yellowness index.

In support of its argument, Albemarle argues that the ASTM method itself reports that the inherent inaccuracy in the Yellowness Index measurements was + 2 YI units at the time the '477 application was filed, and therefore between about 11.0 and about 18 means between about 9.0 and 20. Albemarle also cites the opinions of its experts in support of its + 2 YI unit interpretation.

Great Lakes argues that the intrinsic evidence reveals that the inventor measured the Yellowness Index in his examples given in the specification using two digits to the right of the decimal place, for a total of four significant digits, i.e, to the hundredths' place. Interpretation of the term "about" in the Claim, Great Lakes argues, must be informed by the inventor's use of the hundredths' place in his examples, and his teaching that the Yellowness Index is capable of being measured to one-hundredth of a unit. Great Lakes also points out that the lower limit of the Claim is 11.0, expressed to the tenths' place, or three significant digits, while the upper limit is 18, two significant digits. Great Lakes cited the court to jurisprudence which supported its interpretation, which states that "standard scientific convention" is that when a number has not been carried to the next mathematically significant figure, "about" means the numbers that would "round" to that number. Viskase Corp. v. American Nat'l Can Co., 261 F.3d 1316, 1320 (Fed.Cir.2001). For example, in *Viskase Corp.,* "about 0.91 g/cm" would have been defined, according to standard scientific convention, as 0.905 to 0.914.

As pointed out by Great Lakes, the examples used in the specification, both for comparative purposes and for examples of the invention, measure the yellowness index as follows:

Example I (for comparative purposes)-Y.I. 20.9;

Example II (for comparative purposes)-Y.I. 28.15;

Example III (a process of this invention)-Y.I. 17.85;

Example IV (a process of this invention)-Y.I. 13.78;

Example V (a process of this invention)-Y.I. 17.06.

Example VII, which illustrates a method for purifying diphenylethane, the Y.I. is expressed as 33.2 and 2.8.FN80

FN80. JA-0640-0641.

The lowest number of the invention is expressed as Y.I. 13.78, and the highest number of the invention is expressed as Y.I. 17.85. The Y.I is also expressed to the tenths' place throughout the specification. Nowhere, however, is the Yellowness Index expressed in the specification as whole numbers as Albemarle would have the claim range defined. A more precise measurement than + two whole units is indicated simply by the precision used by the inventor in the specification. While the ASTM may indicate + 2 units of *measurement* variance, this is an indication of variation between measurement inherent in the ASTM method, such as those variations to be expected among different labs and different instruments and does not inform the interpretation of the term "about."

The claim specification supports Great Lakes' interpretation of "about" as the numbers that would round to the numbers 11.0 and 18, as those numbers, 10.95 and 18.4, are reflective of the precision used by the inventor in stating the yellowness index of the product.

For the reasons stated above, the court interprets "between about 11.0 and about 18" as "between 10.95 and 18.4."

Conclusion

IT IS THE RECOMMENDATION of the Magistrate Judge that the court adopt the above definitions for those claim terms in need of construction. A chart is attached to this recommendation for easy reference.

IT IS THE FURTHER RECOMMENDATION of the Magistrate Judge that the court order that the parties may not refer, directly or indirectly, to each other's claim construction positions in the presence of the jury; that they be ordered to refrain from mentioning any portion of this opinion, other than the actual definitions adopted by the court, in the presence of the jury; and, that any reference to claim construction proceedings be limited to informing the jury of the definitions adopted by the court.

M.D.La.,2007.
Albemarle Corp. v. Great Lakes Chemical Corp.