

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

UNION CARBIDE CHEMS. &)
PLASTICS TECH. CORP.)
)
Plaintiff,)
)
v.) Civil Action No. 99-CV-274-SLR
)
SHELL OIL CO.,)
SHELL CHEMICAL CO., and)
CRI CATALYST CO.,)
)
Defendants,)
)

SHELL OIL CO.,)
)
Plaintiff,)
)
v.) Civil Action No. 99-CV-846-SLR
) (consolidated)
)
UNION CARBIDE CORP. and)
UNION CARBIDE CHEMS. &)
PLASTICS TECH. CORP.)
)
Defendants,)
)

Jeffrey B. Bove, Esquire, R. Eric Hutz, Esquire, and Thomas A. Stevens, Esquire of Connolly, Bove, Lodge & Hutz, Wilmington, Delaware. Counsel for plaintiff, counter-defendant. Steven J. Glassman, Esquire, Benjamin C. Hsing, Esquire, and Kimberly D. Branch, Esquire of Kaye, Scholer, Fierman, Hays & Handler, New York, New York. Of counsel for plaintiff, counter-defendant.

Allen M. Terrell, Jr., Esquire and Jeffrey L Moyer, Esquire of Richards, Layton & Finger, Wilmington, Delaware. Counsel for defendant, counter-plaintiff. William C. Slusser, Esquire of Slusser & Frost, Houston, Texas and John D. Norris, Esquire of Howrey, Simon, Arnold & White, Houston, Texas. Of counsel for defendant, counter-plaintiff.

OPINION

Dated: August 28, 2001
Wilmington, Delaware

ROBINSON, Chief Judge

I. INTRODUCTION

Union Carbide Chemicals & Plastics Technology Corporation is the assignee of all rights, title, and interest in and to U.S. Patent Nos. 4,916,243 ("the '243 patent"); 4,908,343 ("the '343 patent"); and 5,057,481 ("the '481 patent"). These patents relate to improved catalysts used to produce ethylene oxide. Ethylene oxide is a building block chemical used to make numerous household products including shampoo, antifreeze, and laundry detergent.

Generally speaking, ethylene oxide is made by combining ethylene and oxygen. When ethylene and oxygen are chemically combined, three main products result - ethylene oxide, carbon dioxide, and water. The carbon dioxide and water are undesirable byproducts of the chemical reaction. The efficiency of the reaction is measured by comparing the amount of ethylene oxide produced to the amount of ethylene and oxygen used in the process. Scientists, including those employed by the parties in this litigation, have tried for years to improve the efficiency of the reaction. Simply put, they want to produce more ethylene oxide and less carbon dioxide and water.

One well known technique of increasing the efficiency of the reaction is to combine the ethylene and oxygen in the

presence of a silver catalyst. When a silver catalyst is present, oxygen combines with the silver and, through that combination, oxygen is caused to react with ethylene to form ethylene oxide. See the '343 patent, col. 2, lns. 10-15. Since at least the 1930s, scientists have been trying to improve the silver catalysts to increase the efficiency of the reaction and the life of the catalyst. One way to improve the silver catalysts is to add other metals to the silver. These other metals are referred to as "promoters."

Union Carbide Chemicals & Plastics Technology Corporation filed this patent infringement action on May 3, 1999 against defendant Shell Oil Company, Shell Chemical Company, and CRI Catalyst Company (collectively, "Shell"), alleging that Shell infringes the '243 patent, the '343 patent, and the '481 patent (collectively, "the patents-in-suit").¹ Shell countered that all three patents-in-suit were invalid and not infringed. Union Carbide Corporation joined this litigation on January 4, 2000. Union Carbide Chemicals & Plastics Technology Corporation and Union Carbide Corporation are referred to collectively as "Union Carbide."

¹By trial, Union Carbide limited its charges of infringement to claim 4 of the '243 patent; claims 1, 3, 13, 25, and 41 of the '343 patent; and claims 1, 3, 4, and 28 of the '481 patent.

Shell Oil Company had filed suit against Union Carbide in April 1999 in Houston, Texas. That case was transferred here and consolidated with this action. The consolidated action was tried to a jury over twelve days. After two and one-half days of deliberations, the jury found that Shell did not infringe any claims of the patents-in-suit and that each asserted claim was invalid. The jury also answered willful infringement and damages interrogatories, checking "No" for all three willful infringement questions and finding \$0.00 in damages based upon a 0% royalty.

Union Carbide is incorporated in Delaware and has its principal place of business in Connecticut. (D.I. 75, ¶¶ 4-5) Shell is a Delaware corporation with its principal place of business in Texas. (D.I. 75, ¶¶ 7-9; D.I. 78 ¶¶ 7-9) The court has jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338. Venue is proper in this judicial district by virtue of 28 U.S.C. §§ 1391(c) and 1400(b).

II. BACKGROUND

A. The Patents-in-Suit and Asserted Claims

The three patents-in-suit can be better understood by grouping them into two categories. Throughout this litigation, the parties referred to the '243 patent as "the

synergy patent" and the '343 and '481 patents as "the salt patents."

The application leading to the '243 patent was a continuation of prior U.S. application Ser. No. 763,273 filed August 7, 1985, which was a continuation of application, now abandoned, Ser. No. 497,231 filed May 23, 1983, which was a continuation of application, now abandoned, Ser. No. 116,292 filed February 13, 1980, now abandoned, which was a continuation-in-part of Ser. No. 021,727 filed Mar. 20, 1979, now abandoned. As described in its specification, the '243 patent comprises a supported silver catalyst containing

a combination of (a) cesium and (b) at least one other alkali metal selected from the group consisting of lithium, sodium, potassium and rubidium, wherein (a) and (b) are present in amounts in relation to the amount of silver therein sufficient to increase the efficiency of the ethylene oxide manufacture to a value greater than the efficiencies obtainable under common operating conditions from respective catalysts which are the same as said catalyst except that instead of containing both (a) and (b), one contains the respective amount of (a), and the other contains the respective amount of (b).

('243 patent, col. 1, lns. 19-28)

Claim 4, which is dependent of claim 1, is the only asserted claim of the '243 patent.

1. In the continuous process for the production of ethylene oxide by the vapor phase oxidation of ethylene with molecular oxygen provided as an oxygen-containing gas at a temperature of from about 200° C. to 300° C. in the presence of at least about one mole percent of carbon dioxide and an organic chloride in the gaseous feed stream and in the presence of a supported, silver-containing catalyst in a fixed bed, tubular reactor used in commercial operations to form ethylene oxide, wherein said supported, silver-containing catalyst contains 2 to 20 weight percent silver deposited on a support which is in a form and size for use in the reactor, wherein (i) the specific reaction conditions of the ethylene oxide process; (ii) the specific catalyst support characteristics and (iii) the specific silver deposition method comprise an ethylene oxide production system, the improvement in which the catalyst comprises silver deposited on an alpha-alumina macroporous support in a first amount having a surface area less than 10 m²/ g and contains a combination of (a) cesium in a second amount and (b) at least one other alkali metal selected from the group consisting of lithium, sodium, potassium and rubidium in a third amount, which combination comprises (a) and (b) in amounts in relation to the amount of silver in the catalyst sufficient to provide an efficiency of ethylene oxide manufacture that is greater than the efficiencies obtainable in the same ethylene oxide production system, including the same conversions, than (i) a second catalyst containing silver in the first amount and cesium in the second amount, and (ii) a third catalyst containing silver in the first amount and the alkali metal in the third amount, wherein the combination of silver, cesium and alkali metal in said

catalyst is characterizable by an efficiency equation:

$$\begin{aligned} \text{efficiency \%} = & b_0 + b_1(BG) + b_2(BCs) + \\ & \sum_1^4 b_{3j} BA_j + b_4(BG)^2 + b_5(BCs)^2 + \\ & \sum_1^4 b_{6j} BA_j^2 + b_7(BG \cdot BCs) + \\ & (BG) \sum_1^4 b_{8j} BA_j + (BCs) \sum_1^4 b_{9j} BA_j, \end{aligned}$$

where $BA_1 = BRb$,

$BA_2 = BK$,

$BA_3 = BNa$,

$BA_4 = BLi$, and where the coefficient b_0 through b_{9j} and BG , BRb , BK , BNa , BLi and BCs are determined from a composite design set of experiments using the same ethylene oxide production system for the independent variables silver, cesium and alkali metal, and wherein BG is the difference of the average value of the silver content from the silver content used in the design set, BCs is the difference of the average value of the cesium content from the cesium content used in the design set . . . and BLi is the difference of the average value of the lithium content from the lithium content used in the design set.

4. The process of claim 1 wherein said alkali metal is lithium.

('243 patent, col. 29, ln. 53 - col. 30, ln. 54)

In other words, the invention is directed to a continuous process for the production of ethylene oxide in the presence of a silver-containing catalyst, wherein the catalyst contains (i) silver in a first amount, (ii) cesium in a second amount, and (iii) at least one other alkali metal selected from the group consisting of lithium, sodium, potassium and rubidium in a third amount. Cesium and lithium² are combined in sufficient amounts, relative to the amount of silver, so as to provide an efficiency for ethylene oxide production that is greater than the efficiency obtained by a catalyst which contains silver in the first amount and cesium in the second amount, or a catalyst that contains silver in the first amount and lithium in the third amount. The '243 patent describes the use of a design set of experiments and the use of a corresponding efficiency equation to determine which combinations of alkali metals achieve a synergistic combination.

The '343 and '481 patents are both continuations-in-part of prior U.S. application Ser. No. 18,809, filed Feb. 20, 1987, now abandoned, which was a continuation of U.S. Ser. No. 640,269, filed Aug. 13, 1984, now abandoned. The "salt

²Since dependent claim 4 is the only asserted claim, the "one other alkali metal" is lithium.

patents" relate to catalysts for the manufacture of ethylene oxide, especially at commercial concentrations in the presence of carbon dioxide gas recycle, which contain impregnated silver on a support having an efficiency-enhancing mixture of salts. The '343 patent requires a cesium salt with an oxyanion selected from a first group of elements³ with at least one other alkali or alkaline metal salt that has an oxyanion from a second group⁴ of elements. The '481 patent requires a cesium salt with an oxyanion of one of the first group of elements in combination with at least one other cesium salt.

The asserted claims of the '343 patent include independent claims 1, 25, and 41, and dependant claims 3 and 13.

1. A catalyst for the manufacture of ethylene oxide by the epoxidation of ethylene containing an impregnated silver

³The first group of elements includes the 29 elements listed in Groups 3b through 7b of the periodic table of elements.

⁴The second group of elements includes all halides of atomic numbers of 9 to 53, inclusive, and oxyanions of elements other than the oxygen therein having an atomic number of 7 or 15 to 83, inclusive, and selected from Groups 3a to 7a, inclusive, and 3b through 7b, inclusive, of the periodic table of elements.

metal on an inert, refractory solid support and an efficiency-enhancing amount, relative to the amount of silver metal, of a mixture of (i) a cesium salt of an oxyanion of an element selected from Groups 3b through 7b inclusive, of the Periodic Table of the Elements, and (ii) at least one of an alkali metal salt of lithium, sodium, potassium and rubidium and an alkaline earth metal salt, in which the anions of such salts are halides of atomic numbers of 9 to 53, inclusive, and oxyanions of elements other than the oxygen therein having an atomic number of 7 or 15 to 83, inclusive, and selected from Groups 3a to 7a, inclusive, and 3b through 7b, inclusive, of the periodic Table of the Elements.

3. The catalyst of claim 1, wherein the support is alpha alumina.

13. The catalyst of claim 3 which comprises sulfate anion.

25. A catalyst for the manufacture of ethylene oxide by the epoxidation of ethylene containing an impregnated silver metal on an inert, refractory solid support and an efficiency-enhancing amount, relative to the amount of silver metal, of a mixture of (i) a cesium salt of an oxyanion of an element selected from Groups 3b through 7b inclusive, of the Periodic Table of the Elements; and (ii) an alkali metal salt of lithium, sodium, potassium and rubidium, in which the anions of such salts are oxyanions of elements other than the oxygen therein having an atomic number of 15 or 83 and selected from Groups 3a to 7a, inclusive, and 3b through 7b, inclusive, of the Periodic Table of the Elements.

41. A catalyst suitable for the manufacture of ethylene oxide comprising an impregnated silver metal on an inert, refractory solid support and an efficiency-enhancing amount, relative to the amount of silver metal, of a mixture of (i) a cesium salt of an oxyanion of an element other than the oxygen therein selected from Groups 3b through 7b, inclusive, of the Periodic Table of the Elements; and (ii) an alkali metal salt of lithium, sodium, potassium and rubidium, in which the anions of such salts are oxyanions of elements other than the oxygen therein having an atomic number of at least 15 to 83 and being from Groups 3b to 7b, inclusive, and from 3a to 7a, inclusive of the Periodic Table of the Elements, which catalyst has been subjected to a process for making ethylene oxide by the reaction of ethylene and oxygen in which a stream comprising ethylene, oxygen, recycled carbon dioxide and a gas phase inhibitor is fed to a fixed bed of said catalyst and ethylene oxide is removed from the fixed bed of said catalyst.

('343 patent, col. 32, ln. 63 - col. 33, ln. 9; col. 33 lns. 18-19; col. 33, lns. 52-53; col. 34, lns. 5-17; col. 34, lns. 53 - col. 35 ln. 3)

The asserted claims of the '481 patent include independent claim 1 and dependent claims 3, 4, and 28.

1. A catalyst for the manufacture of ethylene oxide by the epoxidation of ethylene containing an impregnated silver metal on an inert, refractory solid support and an efficiency-enhancing amount, relative to the amount of silver metal of a mixture of cesium salts, at least one of which is a cesium salt in which the anion thereof is an oxyanion of an element having

an atomic number of 21 to 75 and being from groups 3b through 7b, inclusive, of the Periodic Table of the Elements.

3. The catalyst of claim 1 in which at least one cesium salt is a halide having an atomic number of 9 to 53 or an oxyanion of an element other than the oxygen therein having an atomic number of (i) 7 or (ii) 15 to 83 and being from groups 3a to 7a of the Periodic Table of the Elements.

4. The catalyst of claim 3 in which at least one cesium salt is cesium sulfate.

28. The catalyst of claim 1, wherein said catalyst has been subjected to a process for making ethylene oxide by the reaction of ethylene and oxygen.

('481 patent, col. 27, lns. 48-56; col. 27 lns. 61-68; col. 30, lns. 21-23)

B. The Accused Products

Shell manufactures and sells the six accused catalysts in this litigation. The trade names are S863, S879, S880, S881, S882, and S883. The different catalysts contain different mixtures and amounts of metal promoters. For example, S880 has 33% more lithium than S879. (D.I. 351 at 668) Lithium sulfate is found in S879, S881, and S883, but not S882 or S880. (PTX 906) Nevertheless, for purposes of the infringement analysis, the accused catalysts are treated as essentially the same and, unless otherwise noted, are not distinguished in this opinion.

C. Motions Made at Trial and Post-Trial

At trial, Union Carbide and Shell filed a number of motions for judgment as a matter of law ("JMOLs"), on which the court reserved ruling. Union Carbide filed three JMOLs challenging the sufficiency of the evidence regarding Shell's defenses that: (1) the '343 and '481 patents were anticipated by prior public knowledge; (2) Dr. Ann Lauritzen was the first inventor of the subject matter of the '343 and '481 patents under 35 U.S.C. § 102(g); and (3) the '243 patent was obvious. Shell filed nine JMOLs at trial, most of which were mooted by the jury's verdict in Shell's favor.

With respect to the three issues that Union Carbide filed pre-verdict JMOLs, Union Carbide renewed its JMOLs after trial and seeks JMOL in its favor or, in the alternative, a new trial. With respect to all other unfavorable jury findings, Union Carbide seeks a new trial based on the verdict being against the weight of the evidence. Moreover, Union Carbide moves for a new trial because Shell infected the trial with irrelevant and prejudicial arguments and evidence which produced "an irrationally lopsided and inconsistent verdict which cries out to be overturned." (D.I. 339 at 4)⁵

⁵Union Carbide also filed an unrelated post-trial motion for the return of a privileged document. (D.I. 319) That issue is addressed in the court's discussion of Shell's JMOL

Shell renewed its JMOL on the issue of inequitable conduct and filed a motion for recovery of attorneys' fees. In response, Union Carbide filed a JMOL of no inequitable conduct.

III. STANDARD OF REVIEW

The court is asked to review the jury's findings of non-infringement, lack of enablement, obviousness, priority of invention, and indefiniteness. Infringement is a question of fact. Gart v. Logitech, Inc., 254 F.3d 1334, 1339 (Fed. Cir. 2001). Enablement, obviousness, and priority of invention are questions of law with factual underpinnings. Durel Corp. v. Osram Sylvania, Inc., __ F.3d __, 59 U.S.P.Q.2d 1238, 1241 (Fed. Cir. 2001) (enablement); Tegal Corp. v. Tokyo Electron Am., Inc., __ F.3d __, 59 U.S.P.Q.2d 1385, 1398 (Fed. Cir. 2001) (obviousness); Innovative Scuba Concepts, Inc. v. Feder Indus., Inc., 26 F.3d 1112, 1115 (Fed. Cir. 1994) (priority of invention). Definiteness is strictly a question of law. Union Pac. Resources Co. v. Chesapeake Energy Co., 236 F.3d 684, 692 (Fed. Cir. 2001). By its motion for entry of JMOL or, alternatively, for a new trial, Union Carbide seeks relief

of inequitable conduct.

from an adverse jury verdict. To prevail on a renewed motion for JMOL following a jury trial, a party "must show that the jury's findings, presumed or express, are not supported by substantial evidence or, if they were, that the legal conclusion(s) implied [by] the jury's verdict cannot in law be supported by those findings.'" Pannu v. Iolab Corp., 155 F.3d 1344, 1348 (Fed. Cir. 1998) (quoting Perkin-Elmer Corp. v. Computervision Corp., 732 F.2d 888, 893 (Fed. Cir. 1984)). "Substantial" evidence is such relevant evidence from the record taken as a whole as might be acceptable by a reasonable mind as adequate to support the finding under review." Perkin-Elmer Corp., 732 F.2d at 893. In assessing the sufficiency of the evidence, the court must draw all reasonable inferences from the evidence in the light most favorable to the nonmovant. See id.; Richardson-Vicks Inc. v. UpJohn Co., 122 F.3d 1476, 1479 (Fed. Cir. 1997). The appropriate inquiry is whether a reasonable jury, given the facts before it, could have arrived at the conclusion it did. See Dawn Equip. Co. v. Kentucky Farms, Inc., 140 F.3d 1009, 1014 (Fed. Cir. 1998) (citing Markman v. Westview Instruments, Inc., 52 F.3d 967, 975-76 (Fed. Cir. 1995) (en banc), aff'd, 517 U.S. 370 (1996)). The court may not determine the credibility of the witnesses nor "substitute its choice for

that of the jury between conflicting elements of the evidence." Perkin-Elmer Corp., 732 F.2d at 893.

Likewise, in order to promote finality after trial, as well as to preserve the historical function of the jury as the trier of facts, the court "ought to grant a new trial on the basis that the verdict was against the weight of the evidence only where a miscarriage of justice would result if the verdict were to stand." Williamson v. Consolidated Rail Corp., 926 F.2d 1344, 1352 (3d Cir. 1991).

Since the jury answered only general interrogatories without any specific findings of underlying facts, the jury is presumed to have made such factual findings. Perkin-Elmer Corp. 732 F.2d at 893; Read, 970 F.2d at 821. Therefore, to set aside the jury's verdicts regarding non-infringement, lack of enablement, obviousness, and priority of invention, Union Carbide needs to show that such presumed findings were not supported by substantial evidence. Id.

Because a patent is presumed valid, the quantum of proof required at trial was clear and convincing evidence for all validity challenges.⁶ 35 U.S.C. § 282 (1994) ("A patent shall

⁶The parties dispute which standard of proof applies to Shell's priority of invention challenge to the salt patents. The court need not reach this issue in light of its rulings below.

be presumed valid."); Verdegaal Bros., Inc. v. Union Oil Co. of Cal., 814 F.2d 628, 631 (Fed. Cir. 1987). Thus, in its renewed JMOLs, Union Carbide needs to show that substantial evidence did not support the jury's presumed finding that Shell had established invalidity by clear and convincing evidence. In its motions for a new trial, Union Carbide needs to show that the jury's verdict is against the clear weight of the evidence.⁷

⁷The court disagrees with Shell's contention that Union Carbide waived many of the challenges it now raises because Union Carbide did not file a Fed.R.Civ.P. 50(a) motion on those issues at trial. In Greenleaf v. Garlock, Inc., 174 F.3d 352, 365 (3d Cir. 1998), the Third Circuit drew a clear distinction between post-trial motions based on the sufficiency of the evidence, which require a pre-verdict Rule 50(a) motion, and post-trial motions based on the weight of the evidence. Union Carbide's post-trial motions conform with the rules set forth in Greenleaf.

IV. DISCUSSION

A. The '243 Patent

The jury found that Shell's S863, S880, S881, S882, and S883 did not infringe claim 1 of the '243 patent. The jury also found claim 1 to be invalid under theories of indefiniteness, lack of enablement, and obviousness. Union Carbide challenges each of those findings.⁸

1. Claim Construction

Prior to trial, the court issued a Markman order outlining the court's claim construction. (D.I. 271) The court defined, among other terms, the phrase "characterizable by an efficiency equation" to mean that "the synergistic combinations are determined from the efficiency equation." (Id. at 3-4) Union Carbide argues that (1) the court erred in its claim construction, and (2) Shell improperly argued the wrong claim construction to the jury.⁹

⁸With respect to the obviousness finding, Union Carbide has renewed its pre-verdict JMOL. With respect to the other '243 patent findings, Union Carbide seeks a new trial based on the verdict being against the weight of the evidence.

⁹Union Carbide also objects to the court's construction of the term "the same ethylene oxide production system." Because the court's definition of "characterizable" disposes of all '243 patent issues, the court will not revisit its claim construction of other terms.

The plain meaning of the word "characterizable" means "able to be characterized or described by." However, a review of the '243 patent's claims, specification, and prosecution history dictates a different definition here. See Markman, 52 F.3d at 979. The prosecution history of the '243 patent demonstrates that in order to infringe the claims of the '243 patent, one must use the efficiency equation to determine which combinations of promoters will provide synergy. In the application leading to the '243 patent, one of the named applicants, Dr. Madan Bhasin, described his invention as being "directed to an improvement to commercial ethylene oxide production processes wherein a supported silver catalyst is characterized by, inter alia, having a certain amount of cesium and a certain relative amount of other alkali metal." (JTX 7 at 94) Unlike the prior art, the application purported to be the first to recognize that "the combination of cesium with other alkali metal could synergistically enhance the efficiency of a commercial ethylene oxide catalyst." (Id.) The examiner rejected the application as obvious in light of, among other references, U.S. Patent Nos. 4,168,247 issued to Percy Hayden et al ("Hayden '247"); 4,212,772 issued to Wolf D. Mross et al ("Mross '772"); and 3,962,136 issued to Robert P. Nielsen et al ("Nielsen '136"). The examiner noted that

each of those references teaches the use of cesium and other metals in silver catalysts for the production of ethylene oxide. (Id. at 140-42)

With respect to the Nielsen '136, the examiner noted that "it would be obvious to one skilled in the art to determine at least one optimum combination of cesium and potassium amounts by routine experimentation leading to a catalyst falling within the scope of the claims." (Id. at 142) The examiner further rejected the claims as being indefinite. "The claims are directed to a process of producing ethylene oxide . . . with the improvement encompassing optimum amounts of both cesium and the other alkali metal. . . ." (Id. at 144) "[T]he scope of the claim is incapable of being readily determined, if at all, in the absence of undue experimentation." (Id. at 145) In response, the applicants amended the claims to include the efficiency equation. (Id. at 168) The applicants commented:

[A]pplicants' discovery of this heretofore unknown synergistic effect is applicable to any ethylene oxide production system. . . . [O]nce the ethylene oxide production system is defined thereby fixing the various parameters to precise values, that same ethylene oxide production system is then used to prepare a composite design set of experiments from which the ultimate Efficiency Model equation is obtained. **From that equation, it is a simple matter to determine the combinations of cesium and**

alkali metal which will provide the synergistic effects discussed and claimed herein. . . .

In other words, once the conditions and the parameters for the ethylene oxide production system are set, including but not limited to the specific reaction conditions, the specific catalyst support characteristics, the specific silver deposition method, etc., by virtue of the present invention, it is possible to determine (if it at all exists) a combination of cesium and alkali metal on a supported silver catalyst which will provide a synergistic efficiency.

(Id. at 169-70)(emphasis added).

The applicants further noted that the efficiency equation was added to the claims "such that they now contain the specific efficiency equation by which the synergistic combinations of the present invention are characterizable. . . .

. By means of the teachings of the present invention, applicants are able to precisely determine the amounts of alkali metal combinations which, if any, are able to produce such synergistic effects for any ethylene oxide production system." (Id. at 171-72)

After several more rejections, amendments, arguments, and an appeal, the claims were allowed with the efficiency equation in place. After reviewing the entire prosecution history, the court reaffirms its ruling that the claims at issue require that the synergistic combination of silver,

cesium, and alkali metal in said catalyst is determined from the efficiency equation. The claims are not apparatus claims encompassing all synergistic catalysts. Rather, the claims at issue are product-by-process claims directed to synergistic catalysts with relative amounts of

alkali metals which were determined from the efficiency equation.¹⁰

2. Infringement

The jury found that none of the Shell catalysts infringed claim 4 of the '243 patent. Under § 271(a) of the Patent Act,

[e]xcept as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States . . . during the term of the patent therefor, infringes the patent.

35 U.S.C. § 271(a). Determining infringement is a two-step process. First, the court must construe the asserted claims so as to ascertain their meaning and scope. See Kahn v.

¹⁰Mindful of the split of authority created by the Federal Circuit in Scripps Clinic & Research Found. v. Genentech, Inc., 927 F.2d 1565 (Fed. Cir. 1991) and Atlantic Thermoplastic Co. v. Faytex Corp., 970 F.2d 834 (Fed. Cir. 1992), the court holds that the use of the efficiency equation is a limitation to claim 4 for both infringement and validity purposes.

General Motors Corp., 135 F.3d 1472, 1476 (Fed. Cir. 1998). Second, the claims as construed are compared to the accused device. See id. In order to be found infringing, each and every claim limitation must be present, either literally or by an equivalent, in the accused device. See Dolly, Inc. v. Spalding & Evenflo Cos., 16 F.3d 394, 398 (Fed. Cir. 1994). In the case at bar, Union Carbide had the burden of proving, by a preponderance of the evidence, that every claim limitation was met by the accused device. See Kahn, 135 F.3d at 1476.

At trial, Union Carbide spun the court's claim construction into an "after the fact" infringement test. For purposes of its infringement analysis, Union Carbide broke claim 4 of the '243 patent into four limitations.¹¹ First, the catalysts have to be used commercially for the production of ethylene oxide. Second, the catalysts have to contain both cesium and lithium. Neither of the first two elements were disputed. Third, the catalysts have to be synergistic or meet an "efficiency test" as set forth in the claim. Under this

¹¹Although the parties used the word "element" to describe parts of the claim, the court will use the word "limitation" in this opinion. See Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 563 n.1 (Fed. Cir. 2000)(en banc), cert. granted, 69 U.S.L.W. 3673 (U.S. June 18, 2001) (No. 00-1543).

test, three catalysts are compared. The first catalyst contains an amount of both cesium and lithium. The efficiency of that first catalyst is then compared to two otherwise identical catalysts except that the second catalyst has the same amount of cesium but no lithium and the third catalyst has the same amount of lithium but no cesium.

Union Carbide's expert witness, Dr. Gary Haller, testified that he evaluated the Shell catalysts by first conducting a design set of experiments and measuring the efficiencies of ten catalysts for each of the six Shell catalysts. He then prepared two additional catalysts for each Shell catalyst which were identical to the Shell catalyst except that one had the same amount of cesium but no lithium and the other one had the same amount of lithium but no cesium. The catalysts are shown to be synergistic if the first catalyst (cesium and lithium) has an efficiency greater than either the cesium only or the lithium only catalyst. In each case, the Shell catalysts had an efficiency greater than the cesium only and lithium only catalysts. (D.I. 352 at 910-19) Thus, each of the Shell catalysts met the first three of the four limitations in the '243 patent.

When Dr. Haller reached the fourth limitation, Union Carbide began to deviate from the court's claim construction.

In describing the fourth limitation - that the catalysts be "characterizable by an efficiency equation" - Dr. Haller told the jury the claim required "that you be able to correlate the amounts of cesium and lithium with the efficiency using a particular equation form." (D.I. 352 at 898) With respect to the Shell catalysts, Dr. Haller conducted the design set of experiments, calculated the efficiency of the each Shell catalyst, and created contour plots using the experiment results and parameters. The contour plots have lithium on one axis and cesium on the other axis. See e.g., PTX 79.07. For any combination of the two metals, the catalyst efficiency is depicted in the third dimension. Dr. Haller concluded that the Shell catalysts met the fourth limitation because each contour plot he generated using the efficiency equation showed that each one had a greater efficiency than a cesium optimized catalyst. See e.g., D.I. 352 at 926-28.

Union Carbide is incorrect in its assertion that synergistic catalysts that can be modeled by an efficiency equation infringe claim 4 of the '243 patent. Union Carbide offered no evidence at trial that Shell used an efficiency equation to determine the alkali metal combinations of its catalysts. Thus, the jury's verdict that none of the Shell catalysts infringed the '243 patent will be left undisturbed.

3. Validity

Just as Union Carbide attempted to gloss over the efficiency equation limitation in its case-in-chief infringement analysis, Shell likewise ignored this limitation in its invalidity analysis. The jury found the '243 patent to be invalid as indefinite, not enabled, and obvious.

a. Definiteness

The jury found that Shell had proven by clear and convincing evidence that claim 4 of the '243 patent was indefinite. Union Carbide argues that such a finding is demonstrably unsupported and against the weight of the evidence. A patent's claims must be sufficiently definite that one skilled in the art can determine the precise limits of the claimed invention. See generally, Union Pac. Resources, 236 F.3d at 692. Whether a claim is invalid under 35 U.S.C. § 112, ¶ 2, for indefiniteness is a question of law. Personalized Media Communications, LLC v. Int'l Trade Comm'n, 161 F.3d 696, 702 (Fed. Cir. 1998). The definiteness inquiry focuses on whether those skilled in the art would understand the scope of the claim when the claim is read in light of the rest of the specification. Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1576 (Fed. Cir. 1986).

Even if the written description does not enable the claims, the claim language itself may still be definite. In re Hyatt, 708 F.2d 712, 714-15 (Fed. Cir. 1983); In re Miller, 441 F.2d 689, 693 (C.C.P.A. 1971) ("Breadth is not to be equated with indefiniteness. . . .").

Shell argued at trial that claim 4 is indefinite because the efficiency equation cannot be used to determine synergistic combinations as required by the claim. Shell contends that the equation does not adequately describe the behavior of a cesium-lithium system, the math models are unreliable, and the form of the model is wrong. To support its theories, Shell introduced a report coauthored by Dr. Bhasin that concluded that the efficiency equation was inadequate for a cesium-lithium combination. Without a working math model for a cesium-lithium catalyst, Shell argued that claim 4 is indefinite.

In a 1981 project report,¹² Dr. Bhasin described his testing of cesium-lithium catalysts named HEC-10 and HEC-10A. In the report, Dr. Bhasin wrote:

¹²It is important to note that this date comes more than one year after the applicants filed the CIP application that specifically listed lithium as one of the alkali metals to be combined with cesium. See JTX 5.

The response surface of this system has been mapped fairly well within the promoter limits studied. Its complex shape has prevented the development of reliable math models.

The effect of lithium on a catalyst efficiency confirms that lithium acts, with cesium (synergistically), to modify the silver surface. Additional work with these promising promoters and other mixed alkali promoter systems is continuing and will be the subject of future report.

* * *

Numerous attempts were made to mathematically model the steady state efficiency and temperature. The standard deviation of all models is high, forcing the conclusion that the form of the models is incorrect. Lines of constant efficiency sketched by hand in Figure 4 reveal an unsymmetrical shape that cannot be modeled by a polynomial function.

(DTX 14 at U2602, U2611)

Union Carbide argues that Shell's reliance on the above experiment is misplaced. Instead of showing that the claim is indefinite, the unreliability of the cesium-lithium model for that test, at best, has to do with whether or not the claim describes an operable invention. Union Carbide cites Miles Lab., Inc. v. Shandon, Inc., 997 F.2d 870 (Fed. Cir. 1993), for the proposition that a defendant's contention that "the claims do not describe a workable invention . . . is irrelevant to definiteness under § 112, P 2." Id. at 875.

Thus, if Dr. Bhasin did an experiment on a cesium-lithium catalyst that could not be characterized by the efficiency equation, then that particular catalyst fell outside the scope of claim 4.

The court agrees with Union Carbide that the evidence Shell presented does not render the claim indefinite. If one cannot use the efficiency equation to determine a synergistic combination of alkali metals for a particular catalyst, then that catalyst falls outside the scope of the claim. A single experimental report showing that Union Carbide had difficulty developing the mathematical model for a particular catalyst does not amount to clear and convincing evidence that claim 4 is indefinite.¹³ In fact, it is the efficiency equation itself which makes the claim definite. By use of the efficiency equation, one can determine which combinations of alkali metals fall within the scope of the claim. Therefore, a verdict contrary to that rendered by the jury is compelled.

¹³Shell argues that Union Carbide is estopped from arguing that the catalyst described in DTX 14 is outside the scope of claim 4. DTX 14 mentions two Union Carbide catalysts - HEC 10 and HEC 10A. Union Carbide identified HEC 10A as a catalyst embodied by the '243 patent in various discovery materials. See e.g., D.I. 211 at B8. However, DTX 14 merely depicts an experimental analysis of cesium and lithium catalyst testing that "led to the formulation of HEC-10 and HEC 10A." (DTX 14 at U 2601)

Union Carbide's motion for judgment as a matter of law is granted.

b. Enablement

The jury found that claim 4 of the '243 patent was not enabled. To satisfy section 112 of the Patent Act, the specification must enable a person of ordinary skill in the art to make and use the full scope of the claimed invention. 35 U.S.C. § 112, ¶1. See generally, Union Pac. Resources, 236 F.3d at 690. For claim 4 to be enabled, the specification must teach one of skill in the art how to use the efficiency equation to determine the synergistic combinations, and must do so for the full scope of the invention.

Shell relies on its same argument that the claim is indefinite for the proposition that the claim is not enabled. Shell argued at trial that Union Carbide's internal document, DTX 14, showed that if one skilled in the art used the efficiency equation to determine the appropriate combinations of cesium and lithium, "she would get the incorrect answer." (D.I. 335 at 27; D.I. 357 at 2218-21)

Union Carbide again argues that the test Shell is referring to shows, at best, that the particular catalyst of that experiment fell outside the scope of the patent. Union

Carbide challenged Shell's expert witness, Dr. Paul J. Conn, regarding his conclusions that the patent was not enabled. Dr. Conn agreed that he "understand[s] [the '243] patent well" and that he "understand[s] the claims." (D.I. 358 at 2510) Dr. Conn's conclusion that the patent was not enabled was based on his reading of DTX 14, a research report dated after the filing dates of both the original and CIP applications leading to the '243 patent.

Union Carbide also presented its own evidence rebutting Shell's lack of enablement contentions. For example, Dr. Haller testified he was able to prepare and test the accused catalysts in accordance with claim 4. Union Carbide also points to the fact that the '243 specification provides specific examples of how to prepare catalysts containing cesium and lithium. See e.g., '243 patent, col. 22, lns. 18-57.

The court holds that the weight of the evidence does not support the verdict that claim 4 of the '243 patent is not enabled. The appropriate inquiry is whether one of ordinary skill in the art can use the patent to make and use the full scope of the invention. Shell's reliance on a failed experiment conducted after the filing of the patent application and its expert's conclusion do not, as a matter of

law, amount to clear and convincing evidence that the patent is not enabled. Rather than hindering attempts by those of skill in the art to practice the invention of the '243 patent, the efficiency equation further teaches how to make and use the full scope of the claimed invention. Thus, Union Carbide's motion for a new trial is granted.¹⁴

c. Obviousness

The jury found that claim 4 would have been obvious at the time the invention was made to a person having ordinary skill in the art. A patent is invalid for obviousness

if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

¹⁴Because the record on this issue has been fully developed and the court finds no disputed issues of fact, the court will also enter judgment as a matter of law in favor of Union Carbide on this issue. Because Union Carbide did not make a pre-verdict JMOL attacking the sufficiency of the evidence regarding this issue at trial, it is precluded from making one post-trial. See Greenleaf, 174 F.3d at 364. Union Carbide's motion for a new trial, however, is procedurally proper. See, Fed.R.Civ.P. 59. Conducting a new trial would be a waste of both the parties' and the court's resources. The court is cognizant of the need to follow the procedural directives set out in the Federal Rules and Court of Appeals precedent. However, both parties have had a full opportunity to be heard on this issue; and no undue prejudice will result by the court's granting judgment.

35 U.S.C. § 103. The ultimate determination of obviousness is a question of law based on underlying factual inquiries. See Richardson-Vicks Inc. v. Upjohn Co., 122 F.3d 1476, 1479 (Fed. Cir. 1997). Those factual inquiries involve consideration of the four so-called Graham factors: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the pertinent art;¹⁵ (4) and any secondary considerations of nonobviousness, such as commercial success. See Graham v. John Deere Co. of Kansas City, 383 U.S. 1, 17-18 (1966); B.F. Goodrich Co. v. Aircraft Braking Sys. Corp., 72 F.3d 1577, 1582 (Fed. Cir. 1996). The existence of each limitation of a claim in the prior art does not, by itself, demonstrate obviousness. Instead, there must be a "reason, suggestion, or motivation in the prior art that would lead one of ordinary skill in the art to combine the references, and that would also suggest a reasonable likelihood of success." Smith Indus. Med. Sys., Inc. v. Vital Signs, Inc., 183 F.3d 1347, 1353 (Fed. Cir. 1999). "Such a suggestion or motivation may come from the references themselves, from knowledge by those

¹⁵The factfinder must evaluate the invention, "not through the eyes of the inventor, who may have been of exceptional skill, but as by one of 'ordinary skill.'" Interconnect Planning Corp. v. Feil, 774 F.2d 1132, 1138 (Fed. Cir. 1985).

skilled in the art that certain references are of special interest in a field, or even from the nature of the problem to be solved." Id. at 1356.

Shell argued at trial that claim 4 is obvious in light of Mross '772 and Nielsen '136,¹⁶ both of which were before the examiner during prosecution. Shell witnesses testified that both Nielsen and Mross show synergistic combinations of metals, although they do not recognize the synergy. Shell argues further that, although these references do not teach the use of an efficiency equation and a composite design set of experiments, "the use of a composite design of experiments and a mathematical equation to characterize the relationship between various components in a multi-component system was within the knowledge of one skilled in the art when the initial application was filed." (D.I. 335 at 49)

Shell's evidence fails for a number of reasons. First, Shell did not offer a limitation-by-limitation presentation on the Graham factors. Second, the two references do not explicitly recognize the required synergy, and Shell offered no evidence at trial other than its experts' conclusions that

¹⁶Shell does not contend that the teachings of Nielsen and Mross must be combined to render claim 4 of the '243 patent obvious. Rather, Shell bases its obviousness defense on each reference individually. (D.I. 335 at 48 n.37)

the references inherently exhibit synergy. Third, neither of the two references depict the use of a design set of experiments nor the use of an efficiency equation. Although Shell witnesses testified that such techniques were well-known in the art at the time, the only evidence Shell cited to support that contention was the specification of the '243 patent. A patent's own disclosure cannot be used to suggest that the invention would have been obvious. See In re Dow Chem. Co., 837 F.2d 469, 473 (Fed. Cir. 1988) ("There must be a reason or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicant's disclosure."). Each of these reasons is fatal to Shell's obviousness defense.

The court holds that Shell's evidence fell well short of the required clear and convincing standard required. As such, the court is compelled to render a verdict inconsistent with that reached by the jury. Union Carbide's JMOL on the issue of obviousness of claim 4 of the '243 patent is granted.

B. The '343 and '481 Patents

The jury found that Shell's S879, S880, S881, S882, and S883 did not infringe claims 1, 3, 13, 25, and 41 of the '343 patent nor claims 1, 3, 4, and 28 of the '481 patent. The

jury further found the asserted claims to be invalid under theories of lack of enablement, anticipation, priority of invention, and obviousness. Union Carbide challenges each of those findings.¹⁷

1. Claim Construction

Prior to trial, the court only defined one disputed claim term - "salt." The court defined salt as, "a compound that contains a positively charged component (cation) and a negatively charged component (anion), other than a hydrogen or hydroxyl ion, and is not an oxide." (D.I. 360 at 3319-20) Although the parties asked the court throughout trial to further refine the definition, neither party is challenging the final claim construction.

For purposes of simplification, the claims of the '343 and '481 patents can be broken into a few limitations. Claim 1 of the '343 patent, the broadest claim, requires a catalyst that contains an efficiency-enhancing amount of (1) a cesium oxyanion salt and (2) an alkali metal salt. Claim 1 of the

¹⁷With respect to the anticipation and priority of invention findings, Union Carbide has renewed its pre-verdict JMOL. With respect to the other salt patent findings, Union Carbide seeks a new trial based on the verdict being against the weight of the evidence.

'481 patent, the broadest claim, requires a catalyst that contains an efficiency-enhancing amount of at least two cesium salts wherein at least one of the cesium salts has an anion selected from a particular group of elements.

2. Infringement

The jury found that none of the Shell catalysts infringed the asserted claims of the '343 or '481 patents. At trial, Shell argued that Union Carbide failed to prove the "efficiency-enhancing limitation" of both patents. Shell claimed that Union Carbide only offered evidence showing that the catalysts themselves provided an improved efficiency and not that the specified salts themselves were efficiency-enhancing. Union Carbide argues that Shell deviated from the parties' agreed upon claim construction by articulating its "efficiency-enhancing argument."

The court had not construed the "efficiency-enhancing" limitation in its Markman orders. During claim construction briefing, Union Carbide suggested that the phrase, "an efficiency-enhancing amount, relative to the amount of silver metal, of a mixture of . . ." meant "an amount sufficient to provide an efficiency greater than that of a silver-only catalyst (containing the same weight-percent silver), prepared

on the same support." (D.I. 196 at 11) Union Carbide continued: "In other words, to determine whether one has an efficiency-enhancing amount, relative to the amount of the claimed mixture, one must compare the efficiency of the catalyst with the base value efficiency of a comparable silver-only catalyst." (Id. at 12) Shell did not propose a definition of that term in its opening claim construction brief. (D.I. 187) In its reply to Union Carbide's definition, Shell replied that Union Carbide "presents a completely rewritten construction of the language 'an efficiency-enhancing amount, relative to the amount of silver metal of . . .' found in the claims of the '343 and '481 patents. [Union Carbide's] construction, however, is unnecessary as the quoted language contains no terms of disputed meaning. In any event, Shell agrees with [Union Carbide's] interpretation that 'one must compare the efficiency of the catalyst with a base value efficiency of a comparable silver-only catalyst . . . so long as the testing of the catalyst efficiencies is conducted under the same conditions.'" (D.I. 200 at 11) Thus, the court did not propose its own definition of the term.

Shell argued at trial that Union Carbide failed to prove that the salts of the claims were on the accused catalysts for

the purpose of enhancing efficiency. For example, Dr. Haller admitted on cross examination that he did not know which specific mixtures of cations and anions caused enhancement or exactly how the ethylene oxidation is occurring on the catalyst. (D.I. 353 at 1186, 1190) Dr. Richard Kemp, a former research scientist in Shell's ethylene oxide area and current Union Carbide employee, testified that the enhanced efficiency may be caused by a number of factors.

Q. So on the surface of the catalyst it is an unanswered question whether the cesium is associated with the silver, and whether the rhenium is associated with the silver, or some other unanswered question?

A. As far as I know, that is correct.

Q. To the best of your knowledge, that is still a mystery of science?

A. The exact role and relationship between all the different components of the EO catalysts, is still a mystery.

(D.I. 352 at 735-36)

Union Carbide argues that Shell's arguments are irrelevant to the infringement analysis. Union Carbide contends that the parties' "agreed upon claim construction" merely requires a comparison of "the efficiency of the catalyst with a base value efficiency of a comparable silver-only catalyst." (D.I. 316 at 66) The claims, however,

specifically require "an efficiency-enhancing amount . . . of a mixture of . . . salt[s]." The salts themselves, therefore, must be efficiency-enhancing.¹⁸ Although Union Carbide presented evidence that the salts are, in fact, efficiency-enhancing, the jury's finding that the Shell catalysts did not infringe was not against the clear weight of the evidence.¹⁹ Thus, Union Carbide's motion for a new trial on this issue is denied.

3. Validity

The jury found each claim of the asserted claims of the '343 and '481 patents to be invalid for lack of enablement, anticipation by prior public knowledge or use, prior invention by another, and obviousness. For the reasons set forth below,

¹⁸Union Carbide bore the burden of proving that to the jury.

¹⁹Union Carbide's argument that Shell violated the parties' agreed upon claim construction is without merit. Shell indicated prior to trial that there were no disputed claim terms with regard to the efficiency-enhancing limitation. The lack of a dispute over the meaning of certain claim terms does not obviate a patentee's burden to prove the existence of each limitation of a claim. Union Carbide's reliance on Newman v. Quigg, 877 F.2d 1575, 1581 (Fed. Cir. 1989) and Fromson v. Advance Offset Plate, Inc., 720 F.2d 1565, 1570 (Fed. Cir. 1983) is misplaced. While knowledge of every scientific nuance regarding an invention is not a requirement of patentability, proof of every limitation in a patent claim is a requirement to a finding of infringement.

the court is compelled to enter a verdict contrary to the one reached by the jury.

a. Enablement

The '343 and '481 patents were continuations of patent applications filed in 1984. The '343 patent claims a catalyst containing a mixture of a (1) cesium salt with an oxyanion of one of twenty-nine different elements (including rhenium) and (2) at least one other alkali or alkaline earth metal salt that has an oxyanion selected from a certain list of elements. The '481 patent is similar, but it requires two cesium salts.

Shell argued at trial that Union Carbide did not know how to make a rhenium catalyst at the time of the patent application. In support of its theory, Shell presented evidence that on May 18, 1982, Union Carbide tried but failed to make a rhenium catalyst for testing. (PTX 85 at U 0122494) Shell claimed that Union Carbide's first successful experiment with a rhenium catalyst came in 1988, shortly after Union Carbide scientists received a copy of a European patent application filed by a Shell employee, Dr. Ann Lauritzen. (DTX 65) That application referred to a composition containing silver, a support, rhenium, and at least one other metal. Union Carbide, in fact, had received a copy of the

Lauritzen European patent application and discussed it at a technology review meeting. (DTX 69) Shortly thereafter, Union Carbide began doing more rhenium experiments. Shell argued to the jury that Union Carbide did not know how to make a rhenium catalyst until Union Carbide copied Dr. Lauritzen's work. (D.I. 357 2341-48)

Shell's theory of lack of enablement fails as a matter of law. The appropriate enablement inquiry involves looking at the specification and determining whether one of ordinary skill in the art would be able to practice the full scope of the invention. In support of its theory that the inventors themselves were unable to make and use a rhenium catalyst, Shell pointed to one of Dr. Bhasin's notebooks showing a failed rhenium experiment. Upon closer inspection of that test, however, one finds that the failed experiment was for a catalyst that fell outside the scope of the claims. The claims of both the '343 and '481 patents require a cesium salt. The rhenium experiment found in PTX 65 involved a silver, lithium, and rhenium catalyst. Failing to make a lithium-rhenium catalyst does not amount to clear and convincing evidence that the specification does not teach one of skill in the art how to make and use a cesium-rhenium catalyst. Likewise, proving that Union Carbide conducted

experiments based on tables found in a competitor's patent does nothing to answer the question of whether the specification of the patent enables one of skill in the art to make and use the invention.

Union Carbide presented significant evidence that the '343 and '481 patents were enabled. The patents contain numerous examples of the claimed catalysts and describe in detail how to prepare them. See, e.g., '343 patent, col 25, ln. 8 - col. 32, ln. 61; '481 patent, col 23, ln. 26 - col. 28, ln. 47. In fact, the '481 patent contains specific examples of rhenium catalysts and the method used to prepare them. See '481 patent, col. 26, ln. 29 - col. 28, ln. 47 (listing NH_4ReO_4 as an anion addition). Moreover, Shell's expert admitted on cross-examination that the '481 patent was enabled.

Q. Yesterday you talked about rhenium, do you remember that?

A. Yes, I'm sure I did since that's a component of the high selectivity catalyst.

Q. If you would turn to Column 25 -- 26 of the '481 patent. Isn't it true if you look at Examples 11 and 12, you have rhenium examples in this patent?

A. Yes, that's true.

Q. So this patent tells you how to make cesium-containing catalysts; is that correct?

A. Yes.

(D.I. 358 at 2562)

The court concludes that the weight of the evidence does not support the verdict that the '343 and '481 patents are not enabled. Union Carbide's motion for a new trial on this issue is granted.²⁰

b. Anticipated by Prior Public Knowledge or Use

The jury answered all interrogatories in favor of Shell when asked whether Shell had "proven by clear and convincing evidence that the invention described in any asserted claim was anticipated by prior public knowledge or use." As set forth in the court's charge to the jury, Shell made three contentions with regard to this interrogatory. Shell argued that (1) the '343 and '481 patents are anticipated by U.S. Patent 4,007,135 ("Hayden"); (2) all asserted claims of the '343 patent except claim 13 and all asserted claims of the '481 patent except claim 4 are anticipated by Japanese Patent Laying Open 56-10750 ("Kokai"); and (3) the inventions of the '343 and '481 patents are anticipated by Shell's commercial

²⁰For the same reasons stated above, the court will enter judgment as a matter of law in favor of Union Carbide on this issue. See note 14, supra.

use of S879 catalyst more than one year prior to the effective filing dates of the patents. Since the court does not know which of the three theories the jury adopted, the court will discuss each contention separately.

i. Anticipation by Hayden

A claim is anticipated if each and every limitation is found either expressly or inherently in a single prior art reference. Celeritas Techs., Ltd. v. Rockwell Int'l Corp., 150 F.3d 1354, 1361 (Fed. Cir. 1998); see also PPG Indus., Inc. v. Guardian Indus. Corp., 75 F.3d 1558, 1566 (Fed. Cir. 1996); Scripps Clinic & Research Found., 927 F.2d at 1576. "There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention." Id. at 1576. Thus, the factual inquiry relevant to the anticipation analysis is whether a single prior art reference discloses every limitation of the challenged claim and enables one skilled in the art to make the anticipatory subject matter. See, e.g., PPG Indus., 75 F.3d at 1566.

As with each of the invalidity defenses, Shell had to present clear and convincing evidence that every limitation in

the '343 and '481 patents are found in Hayden. The following exchange between Shell's counsel and Dr. Conn encompassed the entire testimony on the issue of anticipation.²¹

Q. All right. Let me hand you a copy of Defendants' Trial Exhibit 528, please, sir. What is it?

A. This is U.S. Patent 4,007,135 to Hayden, et al.

Q. What's the date of the document?

A. It's February 8th, 1977 it issued.

Q. Is this a document that came out of the Union Carbide files?

A. Yes. It has a Union Carbide production number.

Q. In the top right-hand corner, does it have Dr. Bhasin's name?

A. Yes, it does.

Q. Have you reviewed the disclosure of the Hayden '135?

A. Yes, I have.

Q. Can you look on the front of it and tell us when it was filed?

A. It was filed November 22nd, 1974.

Q. If you would turn back to the claims, please, and tell us what this patent discloses in the way of cations and anions for the use of ethylene oxide catalysts?

A. In terms of the cations, it claims the use of sodium, potassium, cesium and rubidium. And in terms of what you would characterize as anions, it lists,

²¹As discussed below, this exchange also encompassed Shell's entire presentation that the claims at issue are obvious in light of Hayden.

among other things, the elements tungsten, chromium, magnesium -- sorry, not magnesium, tungsten, molybdenum, that falls within that oxyanion category.

Q. Are those elements that would be contained within the claims of the '343 and '481 patents?

A. Yes, they are.

Q. What is the date of the Hayden '135?

A. The date it issued?

Q. Yes.

A. February 8th, 1977.

Q. Do you have an opinion as to whether or not the '343, and '481 patent are anticipated by the Hayden '135 patent?

A. Yes, I do.

Q. What is that opinion?

A. That my opinion is that the claims are anticipated by the '135 patent.

Q. Would the claims of the '135 and '481 patent be obvious in light of the Hayden '135?

A. Did you say the '343 and '481 patent?

Q. Yes.

A. Yes. They would be.

Q. What does Hayden teach? What's the subject of the Hayden patent?

A. The Hayden patent teaches mixtures of alkali metals with a variety of other components, including molybdenum and tungsten oxyanions for on of EO catalyts.

(D.I. 357 at 2352-54)

Shell's evidence that Hayden anticipates the claims of the '343 and '481 patents fall well short of the required

clear and convincing standard. Shell merely pointed out that the invention in both Hayden and the patents-in-suit are comprised of many of the same elements. An appropriate anticipation analysis would require that Shell present evidence that every limitation of the claims corresponded to an element of the Hayden reference. Shell did not do that. Thus, of the possible ways that the jury could have concluded that the claims at issue were anticipated by prior knowledge or use, anticipation by Hayden could not have been one of them.

ii. Anticipation by Kokai

As with the Hayden reference, Shell's presentation on Kokai did not rise to the level required to invalidate the claims based on anticipation. Shell's counsel had the following exchange with Dr. Conn.

Q. I want to direct your attention to not just those first six experiments, but to the disclosure that is contained in the Japanese patent application,²² and the Japanese, complete translation of the Japanese patent.

A. Yes.

Q. Have you reviewed the disclosures

²²At trial, Kokai was sometimes referred to "the Japanese patent."

in the Japanese patent?

A. Yes, I have.

Q. Have you compared those disclosures to the elements of each of the claims of the '343 and the '481 patents?

A. Yes, I have.

Q. I'm going to ask you, have you reached any opinion concerning whether or not the Japanese patents claim, what is contained in some of the claims of the '343, '481 patents, have you reached those opinions?

A. Yes. They did claim some of the elements of it.

Q. All right. Do you have an opinion as to whether the claims of the '343, 1, 3, 25, 41, claims that are in issue in the case, are anticipated by the Japanese patent?

A. Yes, I do.

Q. What does anticipated mean?

A. It means that the catalysts that are claimed were present in the prior literature.

Q. All right. Do you have an opinion whether the claims of the '481, 1, 3, and 28, were anticipated by the Japanese patent described in exhibit -- Defendants' Trial Exhibit 126?

A. Yes, I do.

Q. And what is that opinion?

A. That they are anticipated.

Q. With respect to Claim 13 of the '343, do you have an opinion whether or not that would have been obvious to those skilled in the art from reading the Japanese patent?

A. Yes.

Q. And what is that opinion?

A. That is that it would be obvious to one skilled in the art. The patent itself does not describe the use of sulfate, but it was well-known at the time, and also it was -- in order to prepare catalysts with the combinations of alkali metals and the molybdenum, or tungsten, or the other oxyanions, it's necessary to find soluble salts of the alkali metals to combine with what are generally the anions in other forms that are readily commercially available.

And sulfates are one of those forms that are commonly cited as innocuous or desirable to use.

Q. Did you review Dr. Bhasin's U.K. patent 2,043,481 and does it disclose the use of sulfates?

A. Yes, it does. It discloses sulfates as a soluble salt to use.

Q. What about the Hayden patent?

A. Yes, Hayden describes the use of alkali sulfates as well as sulfates.

Q. Are those patents readily available?

A. Yes, they were.

Q. Were sulfates commonly used?

A. Yes, they are.

Q. I've asked you now about some of the claims with respect to anticipation, one from each of the patents with respect to obvious[ness]. I need to now ask you a combined question. Have you formed an opinion whether or not the claims of the '343 patent, 1, 3, 13, 25, 41, are all obvious in view of the prior art?

A. Yes.

Q. With respect to obviousness, I failed to ask you about Claim 4 of the '481 patent. Have you formed an opinion as to whether or not Claim 4 of the '481 patent,

as you did with respect to Claim 13 in the '343 patent, would be obvious to those skilled in the art over the Japanese patent?

A. Yes.

Q. And what is that opinion?

A. That it's obvious.

Q. All right. With respect to all of the claims of the '481, have you formed an opinion as to whether or not they would be obvious to one skilled in the art in view of the Japanese patent?

A. Yes.

Q. And why? What is it about the Japanese patent that would make it obvious?

A. That combinations of alkali metals in combination with oxyanions are well-known in the Japanese patent.

Q. All right. Does it in there disclose alkali metal complex compounds of molybdenum, tungsten and boron?

A. Yes, it does. And it -- also, it describes, in addition, the mixtures of different alkali metals, and it describes the mixtures of different oxyanions, so that it covers both patents.

Q. All right. Does it give an explanation for why it suggests mixing the alkali metal?

A. Yes, it has -- it discusses the desirability of different of the alkali metals for different purposes.

Some are for efficiency, some for stability, some for activity.

Q. Let's take it a step at a time. Did it refer, first, to the cesium?

A. Yes.

Q. All right. And why did it suggest using cesium?

A. Because, in general, it gives the

higher efficiency.

Q. Something that's --

A. Not too surprising, is it?

Q. All right. Did it also suggest the use of the potassium?

A. Yes, it did.

Q. And for what reason?

A. It cited potassium for the standpoint of stability.

Q. What does that mean?

A. Lasting longer.

* * *

Q. Look at Page 11. What conclusion was drawn about the use of mixtures?

A. The conclusion is after this discussion that I mentioned of the advantages for lifetime or activity, from the foregoing, it is preferred to use the potassium, rubidium and cesium complex compounds in combination. That's mixtures.

Q. All right. And it's not just describing them, it's saying they're preferred?

A. They're preferred, yes.

* * *

Q. What is the analogy between that and the use of cesium and lithium?

A. Well, as I mentioned several times, and Dr. Lauritzen mentioned, the reason that lithium is used in combination with cesium is for lifetime. Cesium is used for the efficiency and lithium for lifetime.

Q. All right. I'm going to move past the Japanese patent now.

(D.I. 357 at 2330-36)

At no time did Shell identify the limitations in the claims and then point to corresponding elements in the Kokai reference. Without, at minimum, correlating limitations and elements, a defendant cannot meet his clear and convincing standard. See e.g., Jamesbury Corp. v. Litton Indus. Prod., Inc., 756 F.2d 1556, 1563 (Fed. Cir. 1985)(unsupported testimony of expert is insufficient to overcome the presumption of validity). Moreover, Union Carbide presented its own evidence showing that certain limitations of the claims at issue were not found in Kokai. Dr. Haller testified that Kokai does not disclose a mixture of cesium oxyanion salt and another alkali metal salt as required by the '343 patent. (D.I. 353 at 1014) Dr. Haller also testified that Kokai fails to disclose a mixture of a cesium oxyanion salt and a second cesium salt as required by the '481 patent. (Id. at 1016-20)

Claim 1 of Kokai, the only claim of the patent, states in its entirety:

A silver catalyst for the production of ethylene oxide which is prepared by subjecting to an impregnation treatment the support containing as principal component, an γ -alumina of less than 0.07% by weight of sodium component and 1-5 m²/g of specific surface area, by means of the impregnant [sic] solution which contains 0.01-0.05 gram equivalent per 1 kg target catalyst of an alkaline metal borate, an alkaline metal molybdate and/or an alkaline

metal tungstate in a decomposable silver solution so as to attain 5-25% by weight of silver retention ratio for the target catalyst, followed by heating to induce a reduction or a thermal decomposition.

(DTX 126 at U170997)

Kokai's specification does hint at using a mixture of compounds. For example, the specification provides that

in view of selectivity, it is most preferred to incorporate the cesium complex compound. However, a decay tendency of the selectivity during the period of use is larger in the order of the potassium complex compound, the rubidium complex compound and the cesium complex compound. From this viewpoint, the potassium complex compound is most preferred. From the foregoing, it is preferred to use the potassium, rubidium and cesium complex compounds in combination.

(DTX 126 at U 171007-08) This passage may suggest that cesium, potassium, and rubidium compounds can be used in combination. However, neither Dr. Conn nor any other witness pointed to recognition in Kokai of the specific combinations required - a combination of a cesium oxyanion salt in with different alkali metal salts for the '343 patent or two cesium compounds for the '481 patent. Thus, of the possible ways that the jury could have concluded that the claims at issue were anticipated by prior knowledge or use, anticipation by Kokai could not have been one of them.

- iii. **Anticipation by Shell's commercial use of its S879 catalyst more than one year prior to the effective filing dates of the patents.**

35 U.S.C. § 102(a) provides:

A person shall be entitled to a patent unless--

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent. . . .

See generally, Woodland Trust v. Flowertree Nursery, Inc., 148 F.3d 1368, 1370 (Fed. Cir. 1998). Section 102(a) establishes that a person can not patent what was already known to others. If the invention was known to or used by others in this country before the date of the patentee's invention, the later inventor has not contributed to the store of knowledge, and has no entitlement to a patent. Accordingly, in order to invalidate a patent based on prior knowledge or use, that knowledge or use must have been available to the public. See Carella v. Starlight Archery, 804 F.2d 135, 139 (Fed. Cir. 1986) (the § 102(a) language "known or used by others in this country" means knowledge or use which is accessible to the public); 35 U.S.C. § 102(a) reviser's note (1952) (noting that "'known' has been held to mean 'publicly known'" and that

"no change in the language is made at this time"); See also Coffin v. Ogden, 85 U.S. (18 Wall.) 120, 124-25 (1873) (accessible hence anticipating prior use); Gayler v. Wilder, 51 U.S. (10 How.) 477, 497-98 (1850) (nonaccessible hence nonanticipating prior use).

Dr. Lauritzen testified that Shell first commercially used its S879 catalyst in August 1987. (D.I. 356 at 2000-01) That date falls more than one year prior to the CIP application which led to the '343 and '481 patents, but after the filing date of the original application. Neither party disputes that for the purposes of the claims at issue, the date of the CIP application is the reference date for the bar date. Thus, an issue for the jury was whether Shell's use of S879 in August 1987 constituted a public use.²³ As the party trying to invalidate the claim, Shell had the burden of producing clear and convincing evidence that the use was a public use.

Shell's evidence that the use of S879 was public consisted of two pieces of evidence. First, Dr. Richard Frank Schimbor, the former head of Shell's catalyst business,

²³Another necessary issue for the jury was to decide whether the composition of S879 anticipated the claims of the '343 and '481 patent. For the reasons explained below, the court will not reach this issue.

testified that when Shell first developed S879, Shell was "out telling everybody, our customers, to be sure to get them interested." (D.I. 359 at 2784) Second, Dr. Lauritzen testified that at the time Shell first commercialized S879, she "believe[d] there was one non-Shell customer who also used the catalyst in this time period." (D.I. 356 at 2006)

Shell's evidence is inadequate to establish that the use was public. A party's testimony concerning a prior public use must be corroborated. Uncorroborated oral testimony concerning a prior public use "is insufficient as a matter of law to establish invalidity of the patent." Finnegan Corp. v. Int'l Trade Comm., 180 F.3d 1354, 1370 (Fed. Cir. 1999). The court is not concluding that Drs. Lauritzen and Schimbor are not credible; rather, the court merely concludes that "such testimony alone cannot surmount the hurdle that the clear and convincing standard imposes in proving patent invalidity." Id.

In contrast to Shell's uncorroborated evidence, the record reflects that all activities surrounding the first commercialization of S879 was done internally within a Shell plant. (D.I. 356 at 2006-07) The technical progress report covering the first commercial charges of S879 is marked "confidential." (DTX 274) Dr. Lauritzen did not have any

specific knowledge that the report had been shown to others outside of Shell. (D.I. 356 at 2008)

Without clear and convincing evidence that the use of S879 was a public use, the court holds that of the possible ways that the jury could have concluded that the claims at issue were anticipated by prior knowledge or use, prior public use of S879 could not have been one of them. Because there was not sufficient evidence to find anticipation by prior public knowledge or use under any of Shell's theories, the jury's verdict must be set aside. Therefore, Union Carbide's motion for judgment as a matter of law on this issue is granted.

c. Priority of Invention

The jury checked all boxes in favor of Shell indicating that Shell had proven by a preponderance of the evidence²⁴ that, "before Madan Bhasin invented the subject matter of any asserted claims, the invention described in any of those claims was made in this country by a prior invention of Ann Lauritzen who had not abandoned, suppressed, or concealed it."

²⁴The parties dispute whether the court provided the jury the correct burden of proof regarding priority of invention. Because the court holds that the jury's verdict must be set aside under either standard, that issue is moot.

Under 35 U.S.C. § 102(g)(2), an applicant is not entitled to a patent if "before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it." See generally, Mycogen Plant Science, Inc. v. Monsanto Co., 252 F.3d 1306, 1309-10 (Fed. Cir. 2001). An inventor can establish that she was the first to invent under section 102(g) by showing either that she was first to reduce the invention to practice or that she was first to conceive the invention and then exercised reasonable diligence in attempting to reduce the invention to practice from a date just prior to the other party's conception to the date of her reduction to practice. 35 U.S.C. § 102(g) ("In determining priority of invention . . . there shall be considered . . . the reasonable diligence of one who was the first to conceive and last to reduce to practice, from a time prior to conception by the other."); Mahurkar v. C.R. Bard, Inc., 79 F.3d 1572, 1578 (Fed. Cir. 1996). Accordingly, for Shell to succeed in challenging the validity the '343 and '481 patents based on Dr. Lauritzen's claim to prior inventorship, Shell must show both (1) that Dr. Lauritzen reduced the invention to practice before Dr. Bhasin, and (2) that Dr. Bhasin did not conceive the invention first and then exercise diligence in

reducing it to practice from before the date of Dr. Lauritzen's conception.

As is stated throughout this opinion, the '343 patent requires a cesium salt and at least one other alkali or alkaline metal salt, and the '481 patent requires two select cesium salts. Focusing on the conception requirement, Shell had to show that Dr. Lauritzen "formed in . . . her mind a definite and permanent idea of the complete and operative invention." Id. at 1577. To show reduction to practice, Shell had to show that Dr. Lauritzen contemporaneously recognized and appreciated the claimed limitations. See Estee Lauder v. L'Oreal, S.A., 129 F.3d 588, 593 (Fed. Cir. 1997).

Union Carbide demonstrated at trial that Dr. Lauritzen did not recognize and appreciate the combination of a cesium salt and at least one other alkali or alkaline metal salt as required by the '343 patent, nor did she recognize and appreciate the combination of the two cesium salts as required by the '481 patent. During questioning about the experiments she conducted prior to filing her patent applications, Dr. Lauritzen repeatedly stated that she did not believe she had certain cesium salts on her catalysts. (D.I. 356 at 2037-42) Dr. Lauritzen admitted that she "did not believe I had salt on

these catalysts." (Id. at 2047) Dr. Lauritzen concluded her cross-examination:

Q. Have you ever made any catalysts containing cesium salts, a mixture of cesium salts?

A. I do not know because I do not know the form of cesium on the catalyst with certainty.

Q. So if you don't know, you can't be sure; is that correct?

A. I have said I do not know.

(Id. at 2049)

Shell notes that Dr. Lauritzen's testimony was based on her understanding that the term "salt" refers to something in the solid crystalline form - a definition narrower than the court's definition. Shell argues that although Dr. Lauritzen did not believe the promoters existed as salts on the finished catalyst, she did appreciate that such promoters could be present as "ions, compounds, or complexes." (Id. at 1980) Because salts are a subset of "ions, compounds, or complexes," Shell contends that so long as Dr. Lauritzen recognized the broader universe of possibilities, she need not have recognized that the promoters be present in the form of salts.

The facts of this case are similar to those in Heard v. Burton, 333 F.2d 239 (C.C.P.A. 1964). Heard was an interference appeal regarding an invention that used eta-

alumina as a catalyst support material for platinum in the process for reforming low octane gasoline. The junior party, Heard, sought to establish priority of invention over the senior party, Burton, by alleging that he reduced to practice a catalyst utilizing platinum and eta alumina in 1949-50, before the April 23, 1952 filing date of Burton's patent application. Id. at 241. Although the catalyst developed by Heard in 1949-50 did, in fact, use eta-alumina as a catalyst support, Heard did not discover that until 1954 - two years after Burton's application. Id. at 242.

The court ruled that Heard was not the prior inventor because he did not recognize and appreciate that his catalyst contained eta-alumina until after Burton filed his application.

[W]e consider it fatal to [Heard's] case that not until after [Burton's] filing date did Heard recognize that his "ammonia-aged" catalyst . . . contained any different form of alumina at all!

We point out . . . that the count calls for a particular form of alumina and we think that appellant's failure to recognize that he had produced a new form, regardless of what he called it, is indicative that he never conceived the invention prior to appellees' filing date.

(Id. at 243).

Unlike Heard, where the junior party eventually recognized the details of his invention, Dr. Lauritzen is still not sure whether her work encompassed catalysts with promoters in the form of salts. Furthermore, if Shell is now claiming that the Lauritzen catalysts contain elements corresponding to each and every limitation of the '343 patent and '481 patent claims, Shell failed to present an element-by-element comparison between the Lauritzen catalysts and the claim limitations. Shell's presentation on the issue mirrored the type of analysis employed to show that Hayden and Kokai anticipated the claims. As discussed above, that type of analysis is insufficient to meet the burden of proof required to invalidate the claims. Thus, Union Carbide is entitled to judgment as a matter of law that the claims at issue are not invalid by reason of prior invention.

d. Obviousness

The jury found that Shell proved by clear and convincing evidence that each of the asserted claims of the salt patents would have been obvious to one of ordinary skill in the art at the time the invention was made. Shell argued at trial that the '343 and '481 patents are obvious in light of both Kokai and Hayden. Shell's first argument is that since Kokai and

Hayden anticipate the patents, the claims are necessarily obvious.

As is discussed above with respect to Shell's claim that Kokai anticipates the salt patents, Shell failed to prove that Kokai discloses the particular mixtures of a cesium oxyanion salt and another alkali earth metal salt as required by the '343 patent or the particular mixture of a cesium oxyanion salt and second cesium salt as required by the '481 patent. Thus, Shell's argument that Kokai renders the claims obvious for this reason fails. Shell's next notes that Kokai discloses three cations (cesium, potassium, and rubidium) and three anions (boron, molybdenum, and boron) as part of its primary teachings. See DTX 126 at U 171007. Shell concludes from this that

[i]t is clear that from these three cations and three anions, nine different individual salts are possible. Of the three cesium salts, two are salts with a Group 3b to 7b oxyanion. Similarly, of the three different potassium salts and three different salts, two each are salts with a Group 3b to 7b oxyanion. Any mixture of one of these two cesium salts and one of these four salts of potassium and rubidium would provide the mixture of salts broadly required by the claims of the '343 patent.

(D.I. 335 at 51)

Although that statement by Shell sets forth a way to visualize a connection between Kokai and the '343 patent, that argument was never made to the jury. Shell provides no citation to the record to support this argument. No witness provided testimony showing how Kokai teaches which specific alkali metals to combine with which specific oxyanion; nor did any Shell witness offer an opinion as to how Kokai would have suggested the required combinations. Without any support in the record for its claims, the weight of the evidence does not support a verdict that the claims of the '343 patent are obvious in light of Kokai.

With respect to Hayden, the court previously outlined Shell's presentation regarding Hayden as an anticipatory reference. See Section IV.B.3.ii.a. supra. That same excerpt of testimony by Dr. Conn is the entire presentation that Shell made to the jury showing that Hayden made the salt patents obvious. The court concludes that such a brief, conclusory analysis is inadequate to meet the clear and convincing standard. Shell did not conduct a Graham analysis with respect to the Hayden reference. Without such an analysis, the weight of evidence falls on the side of the presumption of validity.

Union Carbide's motion for a new trial on the issue of obviousness of the salt patents is granted.²⁵

C. "Inconsistent and Irreconcilable" Jury Verdicts

Union Carbide points to two sets of answers in the jury verdict that it describes as "irreconcilable inconsistencies."

First, the jury found that (1) Shell's S879 catalyst did not infringe any of the asserted claims of the '343 or '481 patents; and (2) each claim of the '343 and '481 patents "was anticipated by prior public knowledge or use." (D.I. 309, questions 2-3, 9) Second, the jury found that (1) "before Madan Bhasin invented the subject matter of the asserted claims [of the '343 and '481 patents], the invention described in [those] claims was made in this country by a prior invention of Ann Lauritzen. . . ."; and (2) the jury found each accused catalyst did not infringe the '343 or '481 patent. (Id., questions 2-3, 10)

The Third Circuit has directed that a district court must search for a way to reconcile seemingly inconsistent jury

²⁵For the same reasons stated above, the court will enter judgment as a matter of law in favor of Union Carbide on this issue. See note 14, supra.

verdicts. In Bradford-White Corp. v. Ernst & Whinney, 872 F.2d 1153 (3d Cir. 1989), the court noted:

[I]t is well established that a verdict must be molded consistently with a jury's answers to special interrogatories when there is any view of the case which reconciles the various answers. In Atlantic and Gulf Stevedores, Inc. v. Ellerman Lines, Ltd., 369 U.S. 355 (1962), the Supreme Court instructed that:

neither we nor the Court of Appeals can redetermine facts found by the jury any more than the District Court can predetermine them. For the Seventh Amendment says that 'no fact tried by a jury, shall be otherwise reexamined in any court of the United States, than according to the rules of the common law.'

369 U.S. at 358-59. Because of this deference to jury findings the Supreme Court explained:

where there is a view of the case that makes the jury's answers to special interrogatories consistent, they must be resolved that way. For a search for one possible view of the case which will make the jury's finding inconsistent results in a collision with the Seventh Amendment.

Bradford-White, 872 F.2d at 1159. See also, Boyanowski v. Capital Area Intermediate Unit, 215 F.3d 396, 407 (3d Cir.

2000)("Inconsistent jury verdicts are an unfortunate fact of life in law, and should not, in and of themselves, be used to overturn otherwise valid verdicts.").

The court recognizes the possibility that the verdicts are internally inconsistent. A more detailed verdict sheet would have provided the court with more guidance as to which theories the jury chose to find invalidity or infringement. The court is satisfied, however, that by setting aside the invalidity verdicts, the possible inconsistencies do not require a new trial on any of the issues. Such an exercise would be futile. For example, under the court's claim construction, Shell would be entitled to summary judgment regarding infringement of the claims of the '243 patent prior to a new trial because Union Carbide can offer no evidence that the synergistic combinations of alkali metals in the Shell catalysts are determined from the efficiency equation. This case is ripe for review at the Federal Circuit, and a new trial will not be granted at this time.

D. Inequitable Conduct

Also pending are cross motions for judgment as a matter of law on the issue of inequitable conduct. (D.I. 326, 329) The two motions address two distinct issues. Union Carbide urges judgment in its favor because Shell failed to provide

notice and present proof of inequitable conduct at trial. Shell urges judgment in its favor based on evidence presented at trial and in an offer of proof submitted outside the presence of the jury.

Union Carbide argues that although inequitable conduct is listed as a defense in both the answer and pretrial order, Shell never presented the issue to the court. Prior to the parties' opening statements the court informed the parties:

And if indeed inequitable conduct is an issue in this case, you need to let me know so we can make arrangements for the presentation of that sort of evidence outside the hearing of the jury. All right?

(D.I. 349 at 201)

With the exception of making an offer of proof after the close of all evidence regarding an opposition Union Carbide made to a Japanese patent application, Shell did not present evidence on the issue of inequitable conduct outside the presence of the jury. The offer of proof came up in the following discussion on the twelfth day of trial immediately before closing arguments:

COUNSEL FOR SHELL: Before you retire, earlier the Court indicated we could make an offer of proof on the Japanese opposition and you allowed us to

reserve that.²⁶

In the interest of time, we have done it in a written submission form and would like to offer it into evidence as an offer

²⁶On the second day of trial, the court sustained an objection to a Shell question to Dr. Bhasin concerning his knowledge about a particular Japanese patent. On the third day of trial, Shell's counsel, Mr. Slusser and Ms. Frost, said:

MS. FROST:

* * *

Second, we would like to revisit, if we could, the Japanese opposition.

* * *

It's their interpretation of the prior art, though, which we believe is critical. Perhaps we could revisit it at another time.

THE COURT: Well, if you want to make your record, you may.

MS. FROST: All right. We would. Shall we do it now?

THE COURT: Yes.

MR. SLUSSER: Your Honor, would it be possible so that we can be efficient with our time to do this at one of the other breaks?

THE COURT: Yes, it would be.

MR. SLUSSER: If it's a matter of making the record, I can be very efficient with doing it then rather than doing it now.

THE COURT: All right.

(D.I. 351 at 533)

of proof as DTX 694 at this time.

THE COURT: All right. Fine.

MR. GLASSMAN: We haven't seen this, so we don't know what it is.

THE COURT: All right. Well, you take a look at it.

* * *

(A brief recess was taken.)

THE COURT: Yes, sir.

MR. GLASSMAN: Your Honor, I just wanted to make a brief comment on the offer of proof submitted by Shell a few moments ago. It relates to the Japanese opposition. Your Honor ruled to January 23rd at page 509 of the transcript that the information was inadmissible.

In addition, in looking briefly at their submission it happens to relate to the inequitable conduct question. We've never been given notice that they wanted to submit any information on any part of the trial on that portion of their proposed case.

In addition, the offer includes five partial deposition transcripts of witnesses that were never offered. In fact, we asked in writing several days ago, Shell, whether they were going to submit any other additional deposition transcripts and they emphatically said they would not and that's part of this.

We believe the offer should therefore be rejected.

THE COURT: All right. As I understand it, this offer of proof is just for purposes of appeal?

MS. FROST: Your Honor, we would have read this evidence in open court before the jury on other issues beside inequitable conduct. A lot of our evidence has come in on other issues and also goes to the issue of inequitable conduct.

What I tried to do was make a record for appeal, which you have permitted me to do, plus I also put that offer of proof in for the Court to consider on inequitable conduct.

You have heard the evidence along with the jury on other issues, but it was ruled to be inadmissible. So what I have done is made the offer of proof for the record and also it's in the record now for the Court's consideration in connection with that issue should the Court choose to do so.

THE COURT: All right. Well, at this point it seems to me this is not the time to take up -- well, we don't have the time to take it up in any more detail. I'm not confident that I remember what the ruling was based on page 506 of the transcript.

So if we need to address it in post-trial briefing, we can, or in post-proceeding argument, but at this point we will just set it aside. It has been offered, it has been identified.

(D.I. 360 at 3162-65)

Throughout the trial, Union Carbide objected to questions and exhibits asked and introduced by Shell that related to the inequitable conduct issue. When a question or exhibit related solely to the issue of inequitable conduct, the court sustained the objections. When a question or exhibit also

related to a jury issue, for example, anticipation, the court overruled the objection.

Union Carbide argues that Shell ran out of time before it ever presented the inequitable conduct issue. Thus, Union Carbide never mounted a defense to inequitable conduct. Shell argues that Union Carbide had notice of the inequitable conduct defense well before trial. Shell argues that they gave the court notice that it was pursuing inequitable conduct.

After opening statements, the parties were told that they were to let the Court know if arrangements for the presentation of inequitable conduct evidence outside the hearing of the jury needed to be made. Shell did not need to present inequitable conduct evidence outside the hearing of the jury since all of the evidence Shell offered on the subject was also relevant to the validity of the patents-in-suit and properly admissible before the jury, as Shell explained to the Court.

(D.I. 331 at 6) Shell contends that the only other inequitable conduct evidence it needed to introduce was the Japanese opposition evidence that the court excluded on the second day of the trial.

The court agrees that neither it nor Union Carbide had notice that Shell was presenting an inequitable conduct defense. Presenting evidence of inequitable conduct is more than just "a matter of making the record." Both sides are entitled to present and rebut evidence on this issue. As is

the court's practice, evidence of inequitable conduct is presented to the court outside the presence of the jury. Had Shell informed the court of its intention to pursue the issue of inequitable conduct, as it was instructed to do, the court would have scheduled time to hear the evidence before or after the jury left for the day or some other time.

Not only was the court unaware that Shell was mounting an inequitable conduct case, Union Carbide was likewise not aware. Union Carbide failed to present its own evidence on the issue. The court holds that Shell waived the issue of inequitable conduct.²⁷

E. Union Carbide's Motion for a New Trial Based on Shell's Counsel's Use of Irrelevant and Prejudicial Evidence and Themes

Union Carbide urges the court to grant a new trial because Shell's counsel "laced [Shell's] defense, from beginning to end, with repeated attempts to paint the patentee, Union Carbide, as a perennial copyist, who had in effect tricked the Patent Office into granting patents, by

²⁷Union Carbide also filed a motion concerning the return of a privileged document. (D.I. 319) Union Carbide claims the document, a letter from its in-house patent counsel to three scientists, DTX 156, was inadvertently produced when it was "sandwiched between copies of two patent references." Because the letter is only relevant to the issue of inequitable conduct, and Shell has waived that defense, the court holds that Shell shall return the document and all copies to Union Carbide.

improperly copying Shell's patents and other prior art." (D.I. 339 at 5) Specifically, Union Carbide complains that Shell: (1) made references to a prior litigation between Union Carbide and Shell; (2) depicted Union Carbide as a "bad act copier" of Shell's "breakthroughs;" (3) suggested that Union Carbide copied Japanese Kokai '750; (4) implicated that Dr. Haller violated the protective order; (5) attacked the length of the prosecution of the patents-in-suit; and (6) alleged that Union Carbide failed to pay foreign counterpart maintenance fees.

Fed.R.Civ.P. 59 governs the granting of new trials.

Motions for new trials can be based upon a claim

that the verdict is against the weight of the evidence, that the damages are excessive, or that, for other reasons, the trial was not fair to the party moving; and may raise questions of law arising out of alleged substantial errors in admission or rejection of evidence or instructions to the jury.

Witco Chem. Corp. v. Peachtree Doors, Inc., 787 F.2d 1545, 1548 (Fed. Cir. 1986) (quoting Montgomery Ward & Co. v. Duncan, 311 U.S. 243, 251 (1940)). Union Carbide contends that "as a matter of fairness," Shell's use of "irrelevant and prejudicial defenses warrants a new trial." Because the issue of whether Shell's counsel presented irrelevant and prejudicial evidence is not unique to patent law, Third

Circuit law will apply. See Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1574 (Fed. Cir. 1996).

Evidence is relevant if it has "any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence." Fed.R.Evid. 401. Generally, all relevant evidence is admissible. Fed.R.Evid. 402. However, Rule 403 authorizes the exclusion of relevant evidence "if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence."

Not all improper remarks will warrant the granting of a new trial. The test is whether the improper assertions made it "reasonably probable" that the verdict was influenced by prejudicial statements. Fineman v. Armstrong World Indus., Inc., 980 F.2d 171, 207 (3d Cir. 1992)(citing Draper v. Airco, Inc., 580 F.2d 91, 97 (3d Cir. 1978)). In the instant case, the court must review all the remarks made by Shell's counsel and first determine whether the remarks were improper. Union Carbide contends that several remarks were improper because they were irrelevant while others were just highly

prejudicial. If the court concludes that the remarks were improper, then the court must decide whether it is "reasonably probable" that the improper remarks influenced the verdict. For the reasons that follow, Union Carbide's motion is denied.

1. **Shell's Mentioning of a Prior Litigation and Accusations that Union Carbide is a "Bad Act Copier"**

During the 1980s, Shell and Union Carbide were involved in litigation involving the same ethylene oxide catalyst business. See Shell Oil Co. v. Union Carbide Corp., No. 83-5208 (E.D. La. 1983). On June 16, 1986, the parties entered into a consent decree whereby Union Carbide agreed that some of its catalysts infringed certain Shell patents. (DTX 191 at U223971)

Union Carbide was the first party to mention the prior litigation with one comment in its opening statement:

A Shell scientist, a Dr. Nielsen, got some patents involving some of these alkaline metals back in the 1970's.

* * *

You may hear that Shell sued Union Carbide more than 15 years ago over these old patents, but they've all expired now, and that case was settled a long time ago.

(D.I. 349 at 127-29)

Shell responded by making remarks about the prior lawsuit and Union Carbide's tendency to copy. Because the examples are numerous, only a select few comments are listed:

I am proud to represent the Shell Companies in the case because it was Shell that first invented and patented the ethylene oxide catalyst technology that is the basis of this lawsuit.

* * *

The evidence in this case will be that

Shell's technology is generally regarded as the state of the art ethylene oxide technology. Based on breakthroughs that were made by Shell scientists and long ago patented by Shell and sold to customers around the world.

In fact, the whole point of this case is that it was Shell's patents that Union Carbide copied. Shell's already issued patents that Union Carbide copied in an urgent need, Carbide's own words, in an urgent need to remain competitive and to try and repackage some little piece of Shell's inventions, so they could claim something as their own.

It is the result of that copying by Union Carbide that resulted in these three dusty old copycat patents.

* * *

In one instance, Shell had authorized Union Carbide to operate under a secrecy agreement, one of its catalysts in the Union Carbide pilot plant for a year to evaluate whether they wanted to use it.

After that time they analyzed it for months, and even though they concluded that the Shell catalyst was far better than anything they had, they made the fundamental decision, please remember and look for in the evidence that red letter event.

Union Carbide made a fundamental decision to give up on their own research, their work, and copy Shell.

The evidence is going to be clear and convincing that rather than respect Shell's patented rights and rather than hope for a miracle, rather than hope for a miracle, their words, in their own research lab, they chose instead to repeatedly not just copy Shell's first breakthrough, but later when Shell made the next one, to repeatedly copy Shell.

Many years later, Shell's first breakthrough by Dr. Robert Nielsen in the 1970's, Shell's next major breakthroughs by

Dr. Lauritzen were in the '80's. Each time Union Carbide immediately started copying them and they couldn't even get their variations on the Shell theme until patents issued in '90 and '91.

Ladies and gentlemen, there will be no dispute in this case that the Union Carbide patents are not new patents. So as you listen to the evidence, consider why, why do you suppose if these three old patents are as valuable as they come into this courtroom and pretend that they are, why did they sit on the shelf at Carbide for nearly ten years after they issued?

The evidence in this case is going to be primarily from Union Carbide's own documents, the story of a company that simply copies instead of invents. And a company that is finally fallen on desperate enough times that it must come and compete in a courtroom because it can no longer compete in research laboratory or in the ethylene oxide catalyst business.

In this courtroom, even with expensive lawyers and very well educated experts, Union Carbide's own tests, the ones they ran to bring into this courtroom for you, the ones that they rigged to try and get the result they wanted just like they did when they were copying Shell in the research lab, those very tests will prove exactly the opposite of what they're trying to convince you.

Their own tests will prove that Shell is using its own technology. Their own tests will prove that what they have claimed in their patents is wrong, technically wrong. That's what happens when you're trying to copy others instead of invent, you just don't get it quite right.

* * *

Ladies and gentlemen, Union Carbide has been caught once copying Shell's technology in this very same catalyst business, and they've gotten one judgment

against them, and they're about to get another one. That's what this lawsuit is all about.

* * *

Now, Dr. Lauritzen's invention came at a very important point in time. And it's not going to be lost on the importance of that to the practicabilities. The evidence is going to be in the case that after Dr. Nielsen's inventions were disclosed, Union Carbide immediately set out to copy them.

* * *

You will see Union Carbide documents full of copying Dr. Nielsen's '136, and '115 patents. That's the combination of alkali metals that they were copying.

They developed what are known as their HEC, high efficiency catalyst copying, Shell, and they got caught. And in 1983, Shell filed a lawsuit against Union Carbide for having copied Dr. Nielsen's inventions. That lawsuit pended three years, and then at the end of a three-month trial, a judgment was entered against Union Carbide. And it's going to be an important part of the evidence in this case.

But the important connection to Dr. Lauritzen is this, in 1980, the Japanese chemical company, Nippon Shokubai, had discovered that tungsten, molybdenum and boron in combination with cesium, rubidium, and the alkali metals had a beneficial effect, and they filed for a patent application from Japan . . . [I]n Japan, it publishes first for people to see, and then it publishes again for people to oppose it. And then after an opposition procedure, the Japanese Patent Office decides whether to grant it.

Well, the Japanese patent published for people to see. What do you think happened? What do you think happened within a company that's a copier?

* * *

They got sued by Shell on Dr. Nielsen's patents. One of the defenses

that they had in the case of using Dr. Nielsen's invention was, No, no, no, the alkali metals in our catalyst, they're not oxide or oxidic compounds as Dr. Nielsen claimed in his patents, on our catalysts, they're salts. They're salts.

That was their defense, one of their defenses in the first lawsuit.

Well, they're wrong. They lost.

But they filed their patent application that is now the '343 claiming salts. But they did that because they were trying to avoid having been caught the first time.

* * *

Well, as it turns out, when you claim them all, one of the things that they claim is rhenium. So while they have claimed it, they have nothing to back it up. And the evidence in this case, what do you want to bet the evidence is going to be when they started running rhenium experiments? Do you want to bet it's just as soon as they saw Dr. Lauritzen's application that published in a foreign patent office?

Don't you want to bet that just as soon as they saw where somebody had broken through the theoretical barrier, that they immediately started running experiments just like Dr. Lauritzen? Look and see in the evidence in this case what put them on to rhenium.

* * *

It's an invention that Shell made and everybody in the industry sat up and took notice. And Union Carbide sat up and took notice, and just like they always do, they started copying Shell.

It's complicated chemistry, but in the final analysis what you're going to be looking for and what we're looking for is we're looking for who is right and who is wrong. And in this case, Shell is right. And ones again, Union Carbide is caught copying and they're wrong.

(D.I. 349 at 5-6, 165, 191-97)

Before court reconvened the next morning, Union Carbide objected to the allegations of copying in Shell's opening statements, characterizing it as a 404(b) propensity argument. (D.I. 350 at 253-54) The court indicated that it would discuss the issue later and that the issue of copying should not be mentioned again until that time. (Id. at 254) During the cross examination of Union Carbide's first witness, the court ruled that references to the prior litigation were improper, however, Shell could question the witness about a subject that was explored on direct examination - the steps that went into the inventive process of the '243 patent. (Id. at 434)

At the end of the same day, Union Carbide brought the issue up again, asking the court to give the jury a curative instruction and to hear arguments on the subject the next morning. (Id. At 505-06) Before the third day of trial began, the court heard arguments from both sides regarding the need for a curative instruction. Union Carbide argued that Shell's "bad act copying" defense should be precluded because it was (1) prejudicial under 404(b) and (2) not listed among defenses in the pretrial order. (Id. at 516-17) Union Carbide sought to preclude Shell's mentioning of Union

Carbide's copying or the prior litigation between the parties unless Shell could demonstrate the relevance of that evidence.

Shell argued that the prior litigation and its characterization of it were permissible because: (1) Union Carbide mentioned it in its opening statement and thus opened the door to the prior litigation; (2) Union Carbide described Shell's behavior by using the concepts of "stealing" and "illegality" in its opening;²⁸ (3) Union Carbide planned to use

²⁸Union Carbide used the word "illegal" nine times during its opening statement. It did not use the word "stealing" or any form of that word. Union Carbide's counsel did, however, say the following statement in his opening:

This case involves Shell taking important Union Carbide inventions without our permission. The United States government, after carefully reviewing the inventions, granted Union Carbide scientists three separate United States patents protecting those inventions.

* * *

We will prove to you that Shell took Union Carbide's property rights in all three of these patents.

Shell knew about the three patents shortly after the US government awarded them to Union Carbide. And indeed, Shell learned of one of them while the government was still examining it.

Shell, whose people are sitting right over here, has been illegally using Union Carbide's inventions ever since. And we will show that they knew that they were infringing these patents.

Now, Shell's illegal activity is called patent infringement. And that illegal activity is exactly why we are here

"the doomed document"²⁹ which would require providing context to Shell's comments about the state of its catalyst business due to Union Carbide's infringement during the prior litigation; (4) Union Carbide used information from the prior litigation to calculate damages in this case; and (5) some of the same catalysts that Union Carbide said are embodied by the '243 patent were the same ones found to infringe the Shell patents in prior litigation. (Id. At 518-25)

The court told the parties that the prior litigation seems to be related to the issues in this case. It told the parties that in terms of referencing the prior litigation, it was "all or nothing." Shell voted for "all" while Union Carbide voted for "nothing." Eventually, the court ruled as follows:

With respect to these documents, so long as there is evidence on what was happening in [the prior litigation], I believe this has some relevance, and I will let them in.

With respect to the all or nothing,

today. A company that takes another's property rights, infringing its patents is required by law to pay damages.

²⁹As part of its willful infringement case, Union Carbide planned to introduce a Shell document summarizing Shell's competitive position in the ethylene oxide market, DTX 595. The document concludes by saying "[u]nless our current leads on producing a new catalyst are successful, this business is doomed."

we're doing nothing. I warn UCC, if you open the door, it stays open, we go to all.

I warn Shell, you try to open the door, you get docked 30 minutes and a curative instruction, at least 30 minutes. We're going to try it, see how it goes.

(Id. at 548)

The parties did not bring up the prior litigation or "bad act copying" again until the fifth day of trial when Union Carbide listed, among other documents to be used at trial, a redacted version of the "doomed document."³⁰ (Id. At 1058-67) On the sixth day of trial, both parties submitted memorandum on the issue of the prior litigation and propensity argument. (Id. at 1238) On the same day, the issue of the prior litigation came up when Union Carbide wanted to present evidence of their damages calculations that incorporated information from the prior litigation. (Id. at 1385-1401; 1457-59; 1536-39) On the eighth day of trial, Union Carbide asked Dr. Lauritzen whether she had seen a particular British patent application. Shell objected because the only time she had seen it was during her deposition in the prior litigation. After a side bar, the court sustained the objection. (Id. at 2026-30) On the tenth day of trial, Shell sought to ask Mr.

³⁰The court ruled, consistent with its "nothing" decision, that the doomed document could be only admitted if redacted to exclude the "doomed" statements and some other statements. (Id. At 1384-85)

Miller, a retired Shell patent attorney, whether the prior litigation affected his decision not to seek an opinion on the '243 patent. The court sustained Union Carbide's objection to such questioning. (Id. at 2750-57)

Both parties refrained from "bad act copying" comments and references to the prior litigation until the closing arguments. During the prayer conference, Union Carbide asked for, among other things, an instruction on the importance of patents to offset the "derogatory remarks towards our patents." (Id. at 2467) Prior to closings, Union Carbide submitted a memorandum in support of its motion to preclude "closing argument of patent copying." (Id. at 3056) After Union Carbide made its closing, the court addressed the motion to preclude the mentioning of copying in the closing.

THE COURT: All right. I have read the paper by Union Carbide on copying. I have some thoughts. But Mr. Slusser, if you would like to make some comment assuming you have seen their motion.

MR. SLUSSER: Well, as a matter of fact, I haven't seen the motion, Your Honor. I do admit that it was among the mountain of things that was around last night.

The comment I'll make is that I believe I'm entitled to argue whatever the evidence shows, and as long as I stay within the admitted evidence, I'm entitled to do that.

THE COURT: Let me give you my thoughts.

In the opening, in Shell's opening

statements, as recited in this paper, comments were made to the prior litigation and it was called proof of copying, and that seemed to be kind of a propensity argument.

Obviously all references to the prior litigation are out, therefore that particular aspect of the argument cannot be referred to at all in the closing.

With respect to the issues that are in the case today, it is my understanding that Shell's - one of Shell's contentions, and there has been evidence on this contention, is that Union Carbide filed its two salt patents before it really knew how to make a rhenium catalyst, therefore, they weren't enabled until after they saw the Lauritzen patents.

Now that's a contingent, obviously seems to me the concept of copying to some extent is relevant to that issue. To the extent that the concept of copying is limited to the prior invention, then I don't believe that it is at all irrelevant or unduly prejudicial.

So I don't know whether this concept is even going to be part of the closing, but it seems to me that it is related to an issue in the case.

Does anyone want to have further comments before we go back and eat something ourselves.

MR. STEPHENS: Your Honor, the essence of our argument against this concept of bad act copying is that it is a character attack and that it is a propensity based character attack.

We concede that if there is an independent basis for relevancy for a suggestion that there was a copying conduct going on that is relevant to the case, that they're entitled to refer to that aspect of copying.

But it is very clear from the opening argument, and I suspect that Mr. Slusser who is a very, very articulate and very

effective attorney, will argue or try to argue again that Union Carbide is, as they said before, merely a company who copies.

And to place that type of character smear to this jury at this juncture in this case, no matter how you disguise it, is wrong. It's a character attack, 404(a) forbids it.

And all we want to make sure that Mr. Slusser in his enthusiasm, and I'm sure there is a lot of it, doesn't go back to this theme that Union Carbide has engaged in bad acts of copying, Union Carbide is a bad company. Therefore you should determine that your defenses are proven because they are a bad company.

We want to make sure there are no character attacks, that's the essence of the motion. And if I'm understanding Your Honor's ruling. You are telling them that they need to confine it to material parties within the case, if that's the case, then I think we're probably in agreement.

THE COURT: That's my understanding of the law under rule of evidence 404. So that is my ruling.

(Id. at 3228-31)

Shell's closing comments did not mention copying as frequently as it did in its opening. Nevertheless, Shell's counsel's remarks included the following:

Good afternoon, ladies and gentlemen.
We end where we began. When I began, I told you that I was proud to represent Shell in this litigation because it was Shell who first invented and patented the ethylene oxide technology. That's the basis of this lawsuit.

* * *

In the course of listening to 12 days of testimony, did it occur to your common sense as you were listening, why? Why are

we here in 2001 instead of having addressed this in 1991 if it's worth hundreds of millions of dollars you're told it is?

Why did it sit on the shelf for ten years?

* * *

You've seen all of this you need to see. Here is the complete translation. And it's right out of Union Carbide's files. Union Carbide, we even close the complete English translation. This not only says there are mixtures, it explains why. You put the cesium in to get the optimum efficiency. You put the potassium in to get the better life. It's preferred to have a mixture.

That, ladies and gentlemen, in patent law, is what you call "anticipated". Something anticipated their patent. That, ladies and gentlemen, in our parlance where I come from, is called copying.

Do you want to see some more?

Union Carbide, Dr. Lauritzen's EPO patent application publishes: Do you remember seeing Dr. Lauritzen's application, DTX 65? Here is when it was received by Union Carbide. Do you remember what's contained in it? Do you remember Table 8? Do you remember Table 8, right out of Dr. Lauritzen's patent?

Do you remember this? EO catalyst technology review, July the 28th, 1988. Three weeks after they got Dr. Lauritzen's patent application.

Do you remember what's in this? What does that look like to you? I don't know what it looks like you to ladies and gentlemen, but where I come from, that's called copying.

(Id. at 3232-34, 3279-81)

2. Other Comments by Shell's Counsel

Union Carbide further complains that Shell: (1)

"maximized the impact of the bad-act copying theme" by repeatedly stressing to the jury that Shell's prior art patents were "breakthroughs;" (2) suggested to the jury that Dr. Haller violated the protective order by first asking Dr. Haller whether he had access to secret Shell information and then asking where Dr. Haller performed his experiments (at Union Carbide facilities); (3) repeated references to the length of prosecution of the patents, the maintenance of foreign counterpart patents, and the length of time Union Carbide waited to file suit; and (4) suggested that Union Carbide was violating IRS regulations in its licensing arrangement between Union Carbide entities.

Without going into further detail on Union Carbide's allegations, the court concludes that Shell's counsel did make numerous improper remarks. According to the test set forth above, the next step is to determine whether the improper assertions made it "reasonably probable" that the verdict was influenced by prejudicial statements. Fineman, 980 F.2d at 207. However, to the extent that the jury's verdict was influenced by any improper remarks, the court has already remedied that through the granting of Union Carbide's JMOLs. The court holds that the remaining verdicts in favor of Shell were not the product of undue prejudice. Rather, Union

Carbide's proof simply failed on those issues.³¹

V. CONCLUSION

For the reasons stated above, the court concludes that there was a legally sufficient evidentiary basis for a reasonable jury to have found that the Shell catalysts do not infringe the claims at issue. Union Carbide's motion for a new trial on infringement is denied. However, the court concludes that there was no legally sufficient evidentiary basis for a reasonable jury to have found the same claims to be invalid. Therefore, Union Carbide's renewed JMOLs regarding validity are granted. Union Carbide's motions for a new trial on the remaining validity issues are also granted. Instead of having a new trial on those issues, the court will enter judgment in favor of Union Carbide on the issues for which it did not make a pre-verdict JMOL. The court holds that Shell is in no way prejudiced because of this. Shell had a full opportunity to be heard on those issues.

To the extent that the jury answered the interrogatories relating to willful infringement and damages, the court sets aside these findings. The jury was instructed to answer those

³¹See the court's discussion of non-infringement of the patents-in-suit supra.

questions only upon a finding of infringement. Since the jury found no infringement, the jury was not supposed to make any findings regarding damages or willfulness.

The court holds that Shell waived any inequitable conduct defense it attempted to make at trial. Therefore its motion for JMOL of inequitable conduct is denied.³² Union Carbide's motion for return of a privileged document is granted. Finally, Shell's motion for attorneys' fees is denied.

An appropriate order shall issue.

³²Union Carbide's motion for JMOL on inequitable conduct is moot in light of the court's ruling.