

# United States Court of Appeals for the Federal Circuit

02-1001, -1020

UNION CARBIDE CHEMICALS & PLASTICS TECHNOLOGY CORPORATION  
and UNION CARBIDE CORPORATION,

Plaintiffs-Appellants,

v.

SHELL OIL COMPANY, SHELL CHEMICAL COMPANY,  
and CRI CATALYST COMPANY,

Defendants-Cross Appellants.

Steven J. Glassman, Kaye Scholer LLP, of New York, New York, argued for plaintiffs-appellants. With him on the brief were Benjamin C. Hsing and Kimberly D. Branch.

William C. Slusser, Slusser & Frost, L.L.P., of Houston, Texas, argued for defendants-cross appellants. With him on the brief were Claudia Wilson Frost, Jayne Partridge, and Laura Friedl Jones. Of counsel on the brief was John D. Norris, Howrey Simon Arnold & White, L.L.P., of Houston, Texas.

Appealed from: United States District Court for the District of Delaware

Chief Judge Sue L. Robinson

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SHELL OIL COMPANY, SHELL CHEMICAL COMPANY,  
and CRI CATALYST COMPANY,

Defendants-Appellees.

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DECIDED: September 20, 2002

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Before MAYER, Chief Judge, DYK, and PROST, Circuit Judges.

Opinion for the court filed by Circuit Judge PROST. Dissenting opinion filed by Chief Judge MAYER.

PROST, Circuit Judge.

This is a patent infringement action in which Union Carbide Chemicals & Plastics Technology Corporation and Union Carbide Corporation (collectively "Union Carbide") brought suit against Shell Oil Company, Shell Chemical Company, and CRI Catalyst Company (collectively "Shell") for infringement of various claims of Union Carbide's U.S. Patents Nos. 4,916,243 ("the '243 patent"), 4,908,343 ("the '343 patent"), and 5,057,481 ("the '481 patent"). Union Carbide appeals from the final decision of the United States District Court for the District of Delaware upholding the jury's verdict of noninfringement of the three patents and denying Union Carbide's motion for a new trial. Union Carbide Chems. & Plastic Tech. Corp. v. Shell Oil Co., 163 F. Supp. 2d 426, 464-65 (D. Del. 2001). Shell cross-appeals the district court's decision granting judgment as a matter of

law (JMOL) in Union Carbide's favor on all of Shell's asserted invalidity defenses, denying Shell's motion for JMOL on the issue of Union Carbide's alleged inequitable conduct, and denying Shell's motion for attorney fees. Id. For the reasons set forth below, we affirm-in-part, reverse-in-part, and remand for further proceedings consistent with this opinion.

## I. BACKGROUND

### A. The Patents

Union Carbide is the assignee of the '243, the '343, and the '481 patents. These patents are directed to improved silver catalysts for the production of ethylene oxide. Id. at 429-30. Ethylene oxide is a chemical used to make substances such as polyester fiber, resin, and film, and it is created when ethylene reacts with oxygen. Id. at 430. This reaction yields three primary products: ethylene oxide, carbon dioxide, and water. Id. The latter two are undesirable byproducts, and for years scientists have sought to improve the efficiency of the reaction by producing more ethylene oxide and less carbon dioxide and water. Id. It is well known in the field that one can increase reaction efficiency by combining the ethylene and the oxygen in the presence of a silver catalyst. Id. This catalyst can itself be improved by the addition of other metals to the silver. Id. These additional metals are referred to as "promoters," and they act both to increase the efficiency of the reaction and to prolong the lifespan of the catalyst itself. Id.

Both parties refer to the '243 patent as the "synergy patent" and the '343 and the '481 patents as the "salt patents." Id. at 430-31. Claim 4 is the only claim of the synergy patent at issue. Id. Claim 4 depends from claim 1, which reads in pertinent part:

1. In the continuous process for the production of ethylene oxide . . . in the presence of a supported, silver-containing catalyst in a fixed bed, tubular reactor used in commercial operations to form ethylene oxide . . . 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 m<sup>2</sup>/g and contains a combination of (a) cesium in a second amount

and (b) at least one alkali metal . . . 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:

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

where

BA<sub>1</sub> = BRb,

BA<sub>2</sub> = BK,

BA<sub>3</sub> = BNa,

BA<sub>4</sub> = BLi, and where the coefficient b<sub>0</sub> through b<sub>9j</sub> 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, BRb is the difference of the average value of the rubidium content from the rubidium content used in the design set, BK is the difference of the average value of the potassium content from the potassium content used in the design set, BNa is the difference of the average value of the sodium content from the sodium 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.

'243 patent, col. 29, l. 53-col. 30, l. 54 (emphases added).

Claim 4, in turn, claims “[t]he process of claim 1 wherein said alkali metal is lithium.”

Id. at col. 30, ll. 60-61. In general terms, therefore, claim 4 is directed to a catalyst that contains a “synergistic” mixture of silver, cesium, and lithium, meaning that the combination of the three metals renders the catalyst more efficient than a comparable silver-cesium or

silver-lithium catalyst would be. Id. at col. 1, ll. 32-33. Additionally, the claimed catalyst must be “characterizable by an efficiency equation” provided in the patent. It is the proper construction of this efficiency equation limitation that is at issue on appeal.

Like the '243 synergy patent, the '343 and the '481 salt patents are directed to silver catalysts for the manufacture of ethylene oxide.<sup>1</sup> Claim 1 of the '343 patent recites:

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 (i) a cesium salt of an oxyanion of an element selected from Groups 3 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 [P]eriodic Table of the Elements.

'343 patent, col. 32, l. 63-col. 33, l. 9 (emphases added). Similarly, claim 1 of the '481 patent recites:

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.

'481 patent, col. 27, ll. 48-56 (emphases added).

In general terms, therefore, both the '343 and the '481 salt patents claim a silver catalyst containing “an efficiency-enhancing amount . . . of a mixture of [salts].” Whereas

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<sup>1</sup> The '343 and '481 patents are both continuations-in-part of prior U.S. application Ser. No. 18,809, filed February 20, 1987, now abandoned, which was a continuation of U.S. Ser. No. 640,269, filed August 13, 1984, now abandoned. Union Carbide, 163 F. Supp. 2d at 432.

the '481 patent claims a mixture of cesium salts, however, the '343 patent claims a mixture of cesium, alkali metal, and alkali earth metal salts.<sup>2</sup>

Shell manufactures and sells ethylene oxide catalysts containing different combinations and amounts of metal promoters. Union Carbide, 163 F. Supp. 2d at 434.

### **B. District Court Litigation**

In April 1999, Shell brought suit against Union Carbide in the Southern District of Texas. Id. at 430. The following month, Union Carbide filed its own action against Shell in the District of Delaware, where the two cases were subsequently consolidated and tried. Id. In its complaint, Union Carbide alleged that six of Shell's silver catalysts infringe Union Carbide's synergy and salt patents. Id. Shell counterclaimed that the patents in suit are invalid and not infringed. Id.

Following a Markman hearing, the court construed the disputed term "characterizable by an efficiency equation" in claim 1 of the '243 patent to mean that "the synergistic combination of silver, cesium, and alkali metal in [the] catalyst is determined from the efficiency equation." Id. at 437 (emphasis added). In other words, the court construed the claim limitation to require that an infringer actually use the efficiency equation identified in the patent to develop its silver ethylene oxide catalysts. The court conceded that this construction departed from the plain meaning of "characterizable," but found that the '243 patent specification and prosecution history justified the departure. Id. at 436-37. The court noted that the patent examiner rejected Union Carbide's initial application, which

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<sup>2</sup> In its complaint, Union Carbide accused Shell of infringing independent claims 1, 25, and 41 of the '343 patent, as well as dependent claims 3 and 13. Id. As for the '481 patent, Union Carbide asserted independent claim 1 in addition to dependent claims 3, 4, and 28. The asserted salt patent claims are all directed to a silver catalyst containing "an efficiency-enhancing amount . . . of a mixture of [salts]," however, id. at 8-10, and on appeal, the parties refer only to claim 1 of both patents.

lacked the efficiency equation, as obvious and indefinite. Id. at 436. In response to the rejection, Union Carbide added the efficiency equation, stating:

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 . . . . 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 productions system.

Id. at 437 (emphases added).

On the basis of such statements, the court concluded that “[t]he 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.” Id. Accordingly, the court instructed the jury that “[t]he word ‘characterize’ is to be used interchangeably with the word ‘determine,’” and that “the phrase shall be construed to mean that the synergistic combinations are determined from the efficiency equation.”

With regard to the ’343 and the ’481 salt patents, the court did not construe the claim term “efficiency-enhancing amount . . . of a mixture of [salts]” in its Markman order. Id. at 443. During the claim construction briefing, Union Carbide suggested that the term 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.” Id. According to Union Carbide, this meant that “to determine whether one has an efficiency enhancing amount relative to the claimed mixture, one must compare the efficiency of the catalyst with the base value efficiency of a comparable silver-only catalyst.” Id. Shell objected to this statement, arguing that it “presents a completely rewritten construction” of the salt patent claims. Id. Shell did agree, however, that the claim language requires one to compare the efficiencies of the accused catalysts with those of comparable silver-only

catalysts, and that those efficiencies must be determined under the same testing conditions. Id. In its final opinion, the court concluded that “the salts themselves . . . must be efficiency-enhancing.” Id. at 444.

After twelve days of trial, a jury returned a verdict that Shell did not infringe Union Carbide’s synergy and salt patents and that each asserted claim of the three patents was invalid. Id. at 430. Specifically, the jury found that the synergy patent was invalid as indefinite and obvious and for lack of enablement and that the salt patents were invalid for lack of enablement, anticipation, priority of invention, and obviousness, id. at 436. Finally, despite its finding of noninfringement, the jury checked “No” for all three willful infringement interrogatories and found \$0.00 in damages based upon a 0% royalty. Id. at 430.

Before the case was submitted to the jury, both parties had filed a number of motions for JMOL. Id. at 434. Union Carbide had filed three such motions challenging the sufficiency of the evidence regarding Shell’s defenses that (1) the synergy patent was invalid as obvious; (2) the salt patents were invalid as anticipated by prior public knowledge; and (3) the salt patents were invalid due to prior inventorship under 35 U.S.C. § 102(g). Id. All three motions were denied. After the verdict, Union Carbide renewed these motions, seeking judgment in its favor or, in the alternative, a new trial. Id. Union Carbide also sought a new trial on all of the remaining findings of invalidity, as well as on the jury’s verdict of noninfringement. Id. In the alternative, Union Carbide moved for a new trial on the ground that Shell had tainted the trial with irrelevant and prejudicial arguments. Id. Shell had filed nine motions for JMOL at the close of evidence, including one on the issue of Union Carbide’s alleged inequitable conduct before the PTO. Id. Shell renewed this motion after the verdict, and Union Carbide responded with a motion for JMOL of no inequitable conduct. Id.

The district court denied Union Carbide's motion for a new trial on infringement. Id. at 464. The court concluded that sufficient evidence supported the jury's finding that Shell had not infringed the three patents, and it rejected Union Carbide's alternative argument that Union Carbide was entitled to a new trial because Shell had allegedly contaminated the verdict with irrelevant and prejudicial arguments, id. The court granted, however, Union Carbide's renewed motions for JMOL. Id. at 465. Specifically, the court concluded that the jury's findings that the '243 synergy patent was invalid as obvious and that the '343 and '481 salt patents were invalid as anticipated and for prior invention were not supported by sufficient evidence. Id. at 464-65. The court also granted all of Union Carbide's motions for a new trial on the remaining invalidity issues. Id. at 465. Instead of ordering a new trial, however, the court entered judgment in favor of Union Carbide. Id. Although the court conceded that Union Carbide had failed to move for JMOL on these issues before the case went to the jury, the court reasoned that Shell had had a full opportunity to be heard on the issues and would not be prejudiced by entry of judgment as a matter of law. Id. The court denied Shell's motions for JMOL on Union Carbide's alleged inequitable conduct before the PTO and for attorney fees, thereby rendering Union Carbide's responsive motion on its conduct before the PTO moot. Id. Finally, the court set aside the jury's verdict with respect to willful infringement and damages, stating that the jury's finding of noninfringement precluded it from properly reaching these issues. Id. Union Carbide appeals, and Shell cross-appeals. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(1).

## **II. DISCUSSION**

### **A. The '243 Synergy Patent**

As discussed above, claim 4 of the '243 synergy patent is directed to a catalyst that contains a “synergistic” mixture of silver, cesium, and lithium and is “characterizable by an efficiency equation.” The court construed the claim to include only those catalysts developed with the aid of the efficiency equation, and the jury found that none of Shell’s accused catalysts infringed. *Id.* at 437. On appeal, Union Carbide argues that the district court’s claim construction was erroneous. According to Union Carbide, the efficiency equation claim limitation does not require one to use the efficiency equation to develop a synergistic catalyst but rather describes the properties of the catalysts claimed by the patent. Thus, Union Carbide claims that the court’s construction of independent claim 1, and therefore dependent claim 4, as a product-by-process claim unjustifiably and improperly departs from the ordinary definition of “characterizable.” Additionally, Union Carbide denies that it disavowed the ordinary meaning of the claim language during prosecution of the synergy patent and instead asserts that the prosecution history supports its construction of the term. Specifically, Union Carbide states that it added the efficiency equation in lieu of claiming particular ranges of various amounts of silver, cesium, and lithium and their resulting catalyst efficiencies. Union Carbide consequently urges this court to reverse the judgment of noninfringement and grant its motion for a new trial.<sup>3</sup>

Shell responds that the court construed the disputed claim limitation correctly, and that it properly entered judgment on the jury’s verdict of noninfringement because Union Carbide failed to prove essential elements of its case. According to Shell, Union Carbide is not entitled to rely on the ordinary meaning of “characterizable” because both the patent and its prosecution history reveal that Union Carbide did not intend the term to have that

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<sup>3</sup> In the alternative, Union Carbide relies on Scripps Clinic & Research Foundation v. Genentech, Inc., 927 F.2d 1565, 18 USPQ2d 1001 (Fed. Cir. 1991) to argue that even if claim 4 were a product-by-process claim, the judgment of noninfringement

meaning. Shell argues that the specification emphasizes that the relative combinations of metals in the catalysts “are derived” from “mathematical relationships,”

thereby indicating that the efficiency equation is to be used to determine the combinations of components necessary to make a particular catalyst synergistic. Shell also points to the patent examiner’s initial rejection of Union Carbide’s application on the ground that the claims lacked a readily determinable scope. The examiner approved the application only after Union Carbide added the efficiency equation, stating that “one skilled in the art could use the efficiency equation to determine the correct combinations of silver, cesium and alkali metal to prepare a catalyst with synergistic properties.” Shell argues that the examiner’s statements clearly indicate that claim 4 is limited to those catalysts developed with the aid of the efficiency equation. As such, Shell asserts that we should affirm the district court’s claim construction and its decision to uphold the jury’s finding of noninfringement.

A determination of infringement requires a two-step analysis. First, the court construes the asserted claims in order to determine their proper meaning and scope. Markman v. Westview Instruments, Inc., 517 U.S. 370, 391, 38 USPQ2d 1461, 1471 (1996). The general rule is that the court must presume that the terms in the claims mean what they say and construe them according to their ordinary and accustomed meaning. Johnson Worldwide Assocs., Inc. v. Zebco Corp., 175 F.3d 985, 989, 50 USPQ2d 1607, 1610 (Fed. Cir. 1999). This “heavy presumption” in favor of the claim term’s ordinary meaning is overcome, however, if a different meaning is clearly and deliberately set forth in the intrinsic evidence. See K-2 Corp. v. Salomon S.A., 191 F.3d 1356, 1363, 52 USPQ2d

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should still be reversed because the correct reading of product-by-process claims is that they are not limited to products prepared by the process set forth in the claims.

1001, 1004 (Fed. Cir. 1999); Johnson Worldwide, 175 F.3d at 989, 50 USPQ2d at 1610. Consequently, the court must examine the specification and the applicable prosecution history to determine whether a patentee has chosen to give a claim term a definition other than its ordinary meaning. See Bell Atl. Network Servs. v. Communications Group, Inc., 262 F.3d 1258, 1268, 59 USPQ2d 1865, 1870 (Fed. Cir. 2001); Biovail Corp. Int'l v. Andrx Pharms., Inc., 239 F.3d 1297, 1301, 57 USPQ2d 1813, 1815 (Fed. Cir. 2001). After the court construes the claims, these claims are compared to the accused device. Id.

Claim construction is a question of law that this court reviews de novo. Bell Atl. Network Servs., 262 F.3d at 1267, 59 USPQ2d at 1869. Determination of infringement is a question of fact, which, in the context of a jury trial, we review for substantial evidence. B. Braun Med., Inc. v. Abbott Labs., 124 F.3d 1419, 1423, 43 USPQ2d 1896, 1899 (Fed. Cir. 1997). A party's failure to make a motion for JMOL at the close of evidence, however, substantially narrows the scope of our review of the jury's findings. A party that does not move for JMOL before the case is submitted to the jury cannot on appeal challenge the sufficiency of the evidence underlying presumed jury findings. See Southwest Software, Inc. v. Harlequin Inc., 226 F.3d 1280, 1290, 56 USPQ2d 1161, 1168 (Fed. Cir. 2000); Young Dental Mfg. Co. v. Q3 Special Prods., Inc., 112 F.3d 1137, 1141, 42 USPQ2d 1589, 1592 (Fed. Cir. 1997). Such a party is instead limited to challenging the judgment on the ground that the trial court committed an error of law or abused its discretion. Young Dental Mfg., 112 F.3d at 1142, 42 USPQ2d at 1592.

After examining the intrinsic evidence of record, we conclude that the district court erred when it construed the limitation "characterizable by an efficiency equation" to mean "determined from the efficiency equation." As the district court correctly stated, "the plain meaning of the word 'characterizable' means 'able to be characterized or described by.'" Union Carbide, 163 F. Supp. 2d at 436. The dictionary defines "characterizable" as

“capable of being characterized,” and defines “characterize” as, inter alia, “to describe the essential character or quality of . . . to be a distinguishing characteristic of.” Webster’s Third New Int’l Dictionary (1993).<sup>4</sup> The ordinary meaning of “characterizable by an efficiency equation” is therefore “capable of being described by an efficiency equation.” This meaning controls unless the intrinsic evidence clearly redefines the claim term so as to put one reasonably skilled in the relevant art on notice that Union Carbide intended to assign the term a different meaning. See Bell Atl. Network Servs., 262 F.3d at 1268, 59 USPQ2d at 1870 (“We have previously held that, in redefining the meaning of particular claim terms away from the ordinary meaning, the intrinsic evidence must ‘clearly set forth’ or ‘clearly redefine’ a claim term so as to put one reasonably skilled in the art on notice that the patentee intended to so redefine the claim term.” (citation omitted)). In the instant case, neither the specification nor the prosecution history justifies departing from the ordinary meaning of the claim language.

The synergy patent’s specification is consistent with the ordinary meaning of “characterizable” as “capable of being described by.” The specification states that the efficiency equation can be used to generate a graph, also called a contour map, which “depicts” ranges of efficiency for a particular catalyst preparation at a particular temperature. ’243 patent, col. 12, ll. 21-31. Those synergistic catalysts claimed by the patent fall within certain regions of the contour map, and those not claimed fall outside them. As the Description of the Drawings clarifies:

The area [on the contour map] bound by ordinate, the abscissa and the synergism curve (curve “A”) defines the area of synergism in accordance with the present invention. The area to the right of the synergism curve “A”,

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<sup>4</sup> Although technically a form of extrinsic evidence, dictionaries hold a special place in claim construction, and judges “may . . . rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by the reading of the patent document.” Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1584 n.6, 39 USPQ2d 1573, 1578 n.6. (Fed. Cir. 1996).

represents the area of additive and antagonistic effects as described above, and thus defines mixtures not in accord with the present invention."

Id. at col. 14, ll. 15-22.

Claim 4 of the '243 patent therefore claims ethylene oxide catalysts that contain particular ratios of silver, cesium, and lithium, and the efficiency equation provides a visual and mathematical depiction of these ratios. The equation is not a patented process for developing a particular synergistic catalyst but rather a descriptive tool that defines the scope of the patented invention: silver catalysts containing cesium and lithium in a combination that provides a synergistic, rather than an antagonistic or additive, effect. See id. at col. 8, ll. 12-20. As such, "characterizable by an efficiency equation" means what the plain language says; properly construed, the claim limitation covers those catalysts that are described by the efficiency equation.

The prosecution history also supports this construction of the disputed claim term. As stated above, Shell relies heavily upon statements made by both Union Carbide and the patent examiner during prosecution of the synergy patent to support its argument that "characterizable by" should be construed to mean "determined from." A closer examination of the prosecution proceedings, however, reveals that this argument is without merit. As Shell correctly states, the patent examiner initially rejected Union Carbide's patent application under 35 U.S.C. § 112, ¶ 2 on the ground that the scope of the claim was incapable of being determined in the absence of undue experimentation. The examiner found that "it [was] not readily apparent that only a limited number of catalysts would be encompassed and readily identified from the functional language of the claim." Union Carbide therefore added the "characterizable by an efficiency equation" limitation in order to define the scope of its claims. In other words, Union Carbide sought to overcome the § 112 rejection by limiting the field of catalysts claimed by the '243 patent to those that fall

within the contour model generated by the efficiency equation, i.e., those that are “characterized” by the equation. The examiner’s statements that one could use the efficiency equation to determine the necessary combinations of silver, cesium, and alkali metal to produce a catalyst with synergistic properties were therefore directed to clarifying the scope of the claim and not to rewriting it as a product-by-process claim.

Consistent with the intrinsic evidence, we construe the claim term “characterizable by an efficiency equation” to mean “capable of being described by an efficiency equation.” Because the jury’s verdict of noninfringement was based on an erroneous construction of that term, we reverse and remand for a determination of infringement in accordance with the correct claim construction.<sup>5</sup>

After the verdict, the district court granted Union Carbide’s renewed motion for JMOL on obviousness, Union Carbide, 163 F. Supp. 2d at 442, and its motions for a new trial on indefiniteness and lack of enablement, id. at 465. The court subsequently converted this grant of a new trial to JMOL in Union Carbide’s favor. Id. Like the jury’s finding of infringement, the court’s judgments on Shell’s asserted invalidity defenses were based upon an incorrect construction of claim 4. We consequently reverse and remand for further proceedings without reaching the merits of the court’s conclusions.<sup>6</sup>

## **B. The ’343 and the ’481 Salt Patents**

### **1. Claim Construction**

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<sup>5</sup> Union Carbide’s argument that it is entitled to a new trial on infringement of the ’243 patent because Shell tainted the verdict with irrelevant and prejudicial arguments is therefore rendered moot.

<sup>6</sup> We note, however, that the court’s decision to grant JMOL in Union Carbide’s favor where Union Carbide had failed to move for such judgment before the case was submitted to the jury violates both Third Circuit precedent and Rule 50 of the Federal Rules of Civil Procedure. See discussion at Section II(B)(3)(a)(ii), infra.

As discussed above, the '343 and the '481 patents both claim a silver catalyst containing “an efficiency-enhancing amount . . . of a mixture of [salts].” '343 patent, col. 32, l. 63-col. 33, l. 9; '481 patent, col. 27, ll. 48-56. On appeal, Union Carbide argues that the district court erred when it construed “efficiency-enhancing amount . . . of a mixture of [salts]” to mean that the salts themselves must be efficiency enhancing. According to Union Carbide, the efficiency enhancing limitation requires only that the catalyst containing the salt mixture increase the efficiency of the ethylene oxide reaction, not that the salts be the agents responsible for that increase in efficiency. In support of this argument, Union Carbide relies extensively upon the salt patents' specifications, asserting that they teach that one measures the efficiency of the catalyst overall rather than the efficiency of the salts on the catalyst. In a related vein, Union Carbide argues that due to the uncertain nature of the chemical reactions involved, the only way to measure efficiency enhancement is to measure overall catalyst efficiency.

Finally, Union Carbide asserts that Shell agreed to this construction before trial when it filed its response to Union Carbide's statement of issues on claim construction. In this response, Shell stated that it “agree[d] 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.” Union Carbide argues that this statement clearly reveals that both parties were in accord that a catalyst contains “an efficiency enhancing amount . . . of a mixture of [salts]” if the catalyst's efficiency is greater than that of a comparable silver-only catalyst, and that Shell was therefore bound by that construction at trial.

Shell responds that the court's claim interpretation was correct as supported by the plain language of the claims and the specification. Shell argues that Union Carbide's proposed claim construction effectively reads a limitation out of the claims by failing to

require that the salts themselves enhance the efficiency of the catalyst. Shell also argues against Union Carbide's assertion that Shell violated the parties' pre-trial agreement on the correct construction of the claims. At oral argument, Shell did not dispute the fact that it had agreed that the asserted claims require one to compare the efficiencies of a catalyst containing the salt mixture with those of a silver-only catalyst. Shell maintained, however, that this agreement is not tantamount to a concession that only the catalyst, and not the salts themselves, need be efficiency enhancing to fall within the scope of the claims. Shell agrees that one must compare the relevant salt-containing and silver-only catalysts, but it also argues that, as required by the efficiency enhancing limitation, the salt mixture itself must cause the increase in efficiency observed during the comparison.

We conclude that the district court properly construed the claim term "an efficiency-enhancing amount . . . of a mixture of [salts]" to mean that the salts themselves must enhance the efficiency of the catalyst. As Union Carbide conceded at oral argument, the claim language itself is unambiguous. The term "efficiency-enhancing" modifies the phrase "amount . . . of a mixture of [salts]," clearly indicating that the asserted claims of the '343 and the '481 patents are not directed to all catalysts that both contain salts and are more efficient but rather to those catalysts that are more efficient because they contain a particular mixture of salts. While Union Carbide is correct when it asserts that the claims must be construed in light of the specification, Network, LLC v. Centraal Corp., 242 F.3d 1347, 1352, 58 USPQ2d 1076, 1079 (Fed. Cir. 2001), where the claim language is unambiguous on its face, as it is here, "our consideration of the rest of the intrinsic evidence is restricted to determining if a deviation from the clear language of the claims is specified," Interactive Gift Express, Inc. v. Compuserve, Inc., 256 F.3d 1323, 1331, 59 USPQ2d 1401, 1407 (Fed. Cir. 2001); see also Tate Access Floors, Inc. v. Interface Architectural Res., Inc., 279 F.3d 1357, 1371, 61 USPQ2d 1647, 1657 (Fed. Cir. 2001)

("[L]imitations from elsewhere in the specification will not be read in where, as here, the claim terms are clear.").

In the instant case, the intrinsic evidence does not support such a deviation. On the contrary, the salt patents' specifications indicate that the asserted claims are directed to those catalysts that are rendered more efficient by the presence of a particular mixture of salts. The '343 patent's Detailed Description of the Invention, for example, specifies that "[t]he optimum cesium salt and other alkali metal and/or alkaline earth metal salt concentration for a particular catalyst will be dependent upon performance characteristics, such as, catalyst efficiency, rate of catalyst aging and reaction temperature." '343 patent, col. 14, ll. 20-24 (emphases added). Elsewhere, the '343 specification states that the preferred embodiment of the invention is characterized by a combination of metal salts "so as to achieve a synergistic result," which the specification defines as an efficiency greater than that demonstrated by a catalyst containing either one of the salts on its own. Id. at col. 12, ll. 58-68. Similarly, the '481 specification states that "[b]y the use of mixtures of cesium salts, enhanced performance of the catalyst in terms of one or more of activity, efficiency, stability, and sensitivity to changes in process conditions can be obtained." '481 patent, col. 9, ll. 34-39 (emphases added). The '481 specification also discusses "[t]he ratio of cesium salt to any other alkali metal and alkaline earth metal salt(s), if used, to achieve desired performance." Id. at col. 10, ll. 66-68. In other words, both the '343 and the '481 specifications describe a catalyst that contains a particular amount of a certain combination of salts in order to increase efficiency. Even if, as Union Carbide argues, the specification teaches that one measures the general efficiency of the catalyst rather than the efficiency of the specific salt mixture, this does not change the fact that the specification clearly indicates that it must be a catalyst's salts that enhance that efficiency.

Union Carbide's argument concerning the uncertain nature of the chemical reactions involved is similarly without merit. In effect, Union Carbide argues that because no one is certain exactly how the salts affect the ethylene oxide reaction, one cannot measure the efficiencies of the salts themselves, and the disputed claim term must therefore be construed to encompass any catalyst that both contains a mixture of salts and is more efficient. This argument is undermined, however, by the fact that Union Carbide introduced evidence at trial that the salts themselves enhanced catalyst efficiency. Furthermore, we note that the inventor of the '343 and the '481 inventions chose to claim them by use of the efficiency enhancing limitation. As the patent assignee, Union Carbide must live with the legal consequences of that choice.

Finally, we reject Union Carbide's argument concerning Shell's statement of issues on claim construction. Before the trial court and on appeal, Union Carbide relied heavily on the section of Shell's statement where Shell "agree[d] 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." In Union Carbide's view, this statement reveals that both parties accepted that only the catalyst containing the salts, and not the salts themselves, must be efficiency enhancing. We disagree. Shell's statement does not demonstrate that Shell agreed to Union's Carbide's construction of the efficiency enhancing limitation. As the district court found, Shell did not accept Union Carbide's construction in its statement but instead protested that this construction constituted "a completely rewritten construction of the [claim] language." Union Carbide, 163 F. Supp. 2d at 443. Moreover, Shell asserted that Union Carbide's proposed construction was "unnecessary" because the limitation included no disputed terms. While Shell did consent that the efficiencies of the salt-containing and the silver-only catalysts must be compared,

this agreement is not inconsistent with Shell's view that any increase in the salt-containing catalyst's efficiency must be the result of the salts themselves. Like the district court, we conclude that Shell did not assent to Union Carbide's proposed claim construction prior to trial. See id. Shell was not, therefore, bound by that construction or precluded from arguing a different construction at trial. Cf. Interactive Gift Express, 256 F.3d at 1347, 59 USPQ2d at 1419-20 ("Applying the doctrine of waiver . . . , [the patentee] is precluded from proffering a claim construction on appeal that changes the scope of any of the claim construction positions that it advanced in its binding [claim construction] report."); Key Pharms. v. Hercon Labs. Corp., 161 F.3d 709, 715, 48 USPQ2d 1911, 1915-16 (Fed. Cir. 1998) ("Ordinarily, doctrines of estoppel, waiver, invited error, or the like would prohibit a party from asserting as 'error' a position that it had advocated at the trial.").

Because the district court did not err when it construed "an efficiency-enhancing amount . . . of a mixture of [salts]" to mean that the salts themselves must increase the catalyst's efficiency, we affirm its construction of the disputed terms of the '343 and the '481 patents.

## **2. The District Court's Denial of Union Carbide's Motion for a New Trial on Infringement of the Salt Patents Due to Shell's Allegedly Prejudicial Evidence and Arguments**

Union Carbide argues that even under the district court's construction of the efficiency enhancing claim limitation, it is entitled to a new trial on the issue of Shell's alleged infringement of the salt patents. According to Union Carbide, Shell unfairly tainted the jury's verdict of no infringement by introducing irrelevant and prejudicial evidence and arguments at trial. In the 1980s, Union Carbide and Shell were involved in another lawsuit involving ethylene oxide catalysts. Union Carbide, 163 F. Supp. 2d at 458. As a result of that action, the parties entered into a consent decree whereby Union Carbide agreed that

some of its catalysts infringed certain Shell patents. Id. On appeal, Union Carbide asserts that Shell compromised the fundamental fairness of the instant trial by referring to, inter alia, the prior litigation and Union Carbide's alleged practice of copying Shell's patents. Union Carbide consequently asks this court to reverse the jury's verdict of noninfringement and remand for a new trial. In response, Shell characterizes its allegedly prejudicial statements as isolated instances in the context of a two-week trial and argues that most of these statements were made in response to Union Carbide's own references to the previous lawsuit. Shell also argues that the verdict could not have been tainted by prejudice because Union Carbide simply failed to prove infringement, and it urges us not to disturb the jury's verdict.

"The denial of a motion for a new trial is a procedural issue not unique to patent law which we review under the law of the regional circuit where the appeal from the district court normally would lie – in this case, the Third Circuit." EMI Group N. Am., Inc. v. Cypress Semiconductor Corp., 268 F.3d 1342, 1347, 60 USPQ2d 1423, 1427 (Fed. Cir. 2001); see also Mentor H/S, Inc. v. Med. Device Alliance, Inc., 244 F.3d 1365, 1374, 58 USPQ2d 1321, 1326 (Fed. Cir. 2001) ("Whether a new trial was properly granted is a procedural issue not unique to patent law; we therefore review the trial court's grant of a new trial under the law of the regional circuit." (citing Southwest Software, 226 F.3d 1280, 1290, 56 USPQ2d 1161, 1168 (Fed. Cir. 2000))). Under Third Circuit law:

We review District Court decisions whether to grant a new trial because of alleged attorney misconduct for abuse of discretion. This is because we recognize that in matters of trial procedure the trial judge is entrusted with wide discretion because he or she is in a far better position than we to appraise the effect of the improper argument of counsel. A new trial may be granted only where the improper statements made it reasonably probable that the verdict was influenced by prejudicial statements.

Greenleaf v. Garlock, Inc., 174 F.3d 352, 363 (3d Cir. 1999) (citations and internal quotations marks omitted).

In Greenleaf, the Third Circuit affirmed the district court's determination that counsel's allegedly improper statements were not sufficiently prejudicial to warrant a new trial. Id. at 364. The remarks in question included suggestions that the plaintiff, who had allegedly contracted mesothelioma as a result of occupational exposure to asbestos products, would never recover anything in the absence of a guilty verdict and assertions that such a verdict would "send a message" to the company. Id. According to the Third Circuit, "[t]hese comments do not approach the level of attorney misconduct found to prejudice the jury in our precedents." Id.; see also Lightning Lube, Inc. v. Witco Corp., 4 F.3d 1153, 1178-79 (3d Cir. 1993) (affirming the district court's determination that attempted witness tampering did not result in prejudice requiring a new trial).

In the instant case, the court concluded that "Shell's counsel did make numerous improper remarks" at trial. Union Carbide, 163 F. Supp. 2d at 464. The court included many of these remarks in its opinion, several of which are reproduced below:

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.

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

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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.

Id. at 458-59.

The court concluded, however, that it was not reasonably probable that Shell's improper statements had influenced the jury's verdict of noninfringement. Id. at 464. The

court determined that “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 [on invalidity].” Id. Accordingly, it held that “the remaining verdicts [of noninfringement] in favor of Shell were not the product of undue prejudice.” Id. The court consequently denied Union Carbide’s motion for a new trial on infringement. Id.

We conclude that the court’s denial of Union Carbide’s motion did not constitute an abuse of its discretion. We begin by noting, however, that Shell’s conduct is not acceptable and that the district court’s finding that Shell’s remarks were improper strongly suggests that the court must police attorney trial tactics more carefully. We trust that that will be the case on remand. Improper comments such as Shell’s run the risk of infecting the entire trial. See U.S. v. Zehrbach, 47 F.3d 1252, 1267 (3d Cir. 1995) (observing that “irreparable harm may be inflicted in a moment” as a result of counsel’s improper remarks).

That said, we agree with the district court that Shell’s improper statements were pertinent to issues of invalidity rather than to the question of Shell’s alleged infringement. Even if Shell did attempt to characterize Union Carbide as a copyist, such suggestions would imply that Union Carbide’s patents were invalid for prior inventorship or anticipation, not that Shell’s catalysts failed to contain all of the limitations found in the salt patents. Moreover, the only issue decided by the jury verdict that remains before this court, infringement of the salt patents under the correct claim construction, was not a close question. Accordingly, we conclude that the district court did not abuse its discretion when it found that it was not reasonably probable that Shell’s improper remarks influenced the jury’s verdict of noninfringement. We therefore affirm the court’s denial of Union Carbide’s motion for a new trial on the issue.

### **3. The District Court’s Rulings on Shell’s Invalidity Defenses to the Salt Patents**

At trial, Shell argued that both of Union Carbide's salt patents were invalid for lack of enablement, obviousness, anticipation, and prior invention under 35 U.S.C. § 102(g). Union Carbide, 163 F. Supp. 2d at 444. Before the case was submitted to the jury, Union Carbide moved under Rule 50(a) for JMOL on two of Shell's invalidity defenses: anticipation and prior invention. Id. at 434. The court reserved ruling on both of Union Carbide's motions, id., and the jury found that the asserted claims of the salt patents were invalid on all four grounds, id. at 444. Union Carbide subsequently renewed its pre-verdict motions pursuant to Rule 50(b) for JMOL on anticipation and prior invention, seeking either JMOL in its favor or, in the alternative, a new trial. Id. at 434. With respect to the two remaining invalidity findings, lack of enablement and obviousness, Union Carbide moved for a new trial on the ground that the jury's verdict was against the weight of the evidence.<sup>7</sup> Id.

The court granted Union Carbide's renewed motions for JMOL on anticipation and prior invention. Id. at 451 (anticipation), 453 (prior invention). It also granted Union Carbide's motions for a new trial on lack of enablement and obviousness, concluding that

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<sup>7</sup> Shell incorrectly argues that Union Carbide moved for a new trial on the ground that the evidence was insufficient to support the verdict. Under Third Circuit law, the district court may grant a new trial on the motion of a party or sua sponte if (1) insufficient evidence exists to support the verdict; or (2) the verdict is against the weight of the evidence. Greenleaf, 174 F.3d at 365. In order to move for a new trial on the basis of insufficient evidence, a party must have previously moved for JMOL at the close of evidence under Rule 50(a). Id.; Yohannon v. Keene Corp., 924 F.2d 1255, 1262 (3d Cir. 1991) (“[T]he failure to move for a directed verdict at the close of all evidence does more than limit an aggrieved party's remedy to a new trial. In this Circuit, it wholly waives the right to mount any post-trial attack on the sufficiency of the evidence.”). A Rule 50(a) motion is not required, however, before a party can move for a new trial on the ground that the verdict is against the weight of the evidence. See Greenleaf, 174 F.3d at 365 (holding that Yohannon was not intended to foreclose the grant of a new trial where the party argues the weight, rather than the insufficiency, of the evidence). As the district court stated in its opinion, Union Carbide sought a new trial “based on the verdict being against the weight of the evidence.” Union Carbide, 163 F. Supp. 2d at 444. Shell's argument that Union Carbide's failure to move for pre-verdict JMOL precluded it from moving for a new trial is therefore groundless.

the jury's verdict on these defenses was against the weight of the evidence. Id. at 445 (lack of enablement), 454 (obviousness). Instead of having a new trial on these defenses, however, the court entered judgment in Union Carbide's favor, reasoning that Shell enjoyed a full opportunity to be heard on these issues and that it therefore would not be prejudiced. Id. at 465. We discuss each of the court's invalidity rulings separately.

We review a grant of JMOL de novo, reapplying the district court's JMOL standard anew. See Electro Scientific Indus., Inc. v. Gen. Scanning Inc., 247 F.3d 1341, 1349, 58 USPQ2d 1498, 1503 (Fed. Cir. 2001); Mentor H/S, Inc. v. Med. Device Alliance, Inc., 244 F.3d 1365, 1374, 58 USPQ2d 1321, 1325 (Fed. Cir. 2001). As discussed above, we review the district court's decision to grant a new trial according to regional circuit law. In the Third Circuit, "new trials because the verdict is against the weight of the evidence are proper only when the record shows that the jury's verdict resulted in a miscarriage of justice or where the verdict, on the record, cries out to be overturned or shocks our conscience." Williamson v. Consol. Rail Corp., 926 F.2d 1344, 1353 (3d Cir. 1991). Despite the stringency of this standard, however, the appellate court reviews the district court's decision to grant a new trial for abuse of discretion. Greenleaf, 174 F.3d at 365; EEOC v. State of Del. Dept. of Health & Soc. Servs., 865 F.2d 1408, 1413 (3d Cir. 1989). As the Third Circuit stated in Williamson, "considerable deference remains due" to the district court's decision because "[t]he trial judge observes the witnesses and follows the trial in a way that we cannot replicate by reviewing a cold record." 926 F.2d at 1353 (citations and internal quotation marks omitted).

#### **a. Invalidity for Lack of Enablement**

##### **i. The District Court's Grant of a New Trial on Enablement**

“To be enabling, the specification of a patent must teach those skilled in the art how to make and use the full scope of the claimed invention without ‘undue experimentation.’” Genentech, Inc. v. Novo Nordisk A/S, 108 F.3d 1361, 1365, 42 USPQ2d 1001, 1004 (Fed. Cir. 1997) (quoting In re Wright, 999 F.2d 1557, 1561, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993)). Enablement is determined as of the filing date of the patent application. Hybritech Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1384, 231 USPQ 81, 94 (Fed. Cir. 1986). At trial, Shell argued that the salt patents were not enabled because Union Carbide did not know how to make a rhenium catalyst at the time the patent applications were filed. Union Carbide, 163 F. Supp. 2d at 444. In support of this argument, Shell introduced evidence that Union Carbide had attempted to make such a catalyst but had failed. Id. According to Shell, Union Carbide only succeeded in making a rhenium catalyst in 1988, shortly after it received a copy of a European patent application filed by a former Shell employee. Id. The court rejected this argument on the ground that Shell’s evidence demonstrated that Union Carbide had failed to make a catalyst containing silver, lithium, and rhenium, but not cesium. Id. at 445. Because both salt patents require at least one cesium salt, the court concluded that Shell had not demonstrated that Union Carbide’s patents were not enabled. Id. Furthermore, the court found that Union Carbide had presented significant evidence that the salt patents were enabled, including a concession by Shell’s expert on cross-examination that the ’481 patent was enabled. Id. The court consequently concluded that the jury’s verdict of lack of enablement was against the weight of the evidence and granted Union Carbide’s motion for a new trial on the issue. Id. The court subsequently converted its grant of a new trial into JMOL in favor of Union Carbide. Id. at 445 n. 20.

On appeal, Shell argues that the district court’s decision to grant Union Carbide a new trial on the issue of enablement was erroneous and unjustified because Shell

supported its enablement defense at trial with clear and convincing evidence. Before this court, Shell reiterates its rhenium catalyst argument and also asserts that the salt patents are not enabled because Union Carbide's data reveals numerous examples of catalysts that are not efficiency enhancing even though they were prepared using the combinations set forth in the patent claims.<sup>8</sup> Shell argues that it demonstrated at trial that the presence of these inoperative species renders the salt patents invalid for lack of enablement because they prevent one skilled in the art from practicing the claimed invention without engaging in undue experimentation.

Shell's arguments are without merit. Under 35 U.S.C. § 282, a patent is presumed valid. Shell consequently bore the burden of proving that the salt patents' specifications failed to teach those skilled in the art how to make the claimed invention, namely a catalyst containing an efficiency enhancing amount of a mixture of salts including cesium. See Morton Int'l v. Cardinal Chem. Co., 5 F.3d 1464, 1470, 28 USPQ2d 1190, 1194 (Fed. Cir. 1993) ("The court correctly required [defendant] to prove by clear and convincing evidence facts establishing lack of enablement."). The district court therefore did not abuse its discretion when it found Shell's evidence concerning Union Carbide's failure to make a lithium-rhenium catalyst irrelevant. See Durel Corp. v. Osram Sylvania Inc., 256 F.3d 1298, 1306-07, 59 USPQ2d 1238, 1244 (Fed. Cir. 2001) (only the claimed invention need be enabled). Nor are we convinced by Shell's undue experimentation argument. Shell supported this argument at trial with testimony by its expert witness, Dr. Conn, that he had

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<sup>8</sup> Shell also makes several arguments related to the filing date of the salt patents' parent application. The '343 and the '481 patents are both continuations-in-part of a prior application, now abandoned. Union Carbide, F. Supp. 2d at 431. According to Shell, Union Carbide relied on the parent patent's original filing date at trial, and Shell argues that the asserted claims of the salt patents must therefore be enabled as of that date. At oral argument, however, Shell did not direct the court's attention to any point at which Union Carbide relied upon the original filing date. Moreover, in its brief, Union

found “hundreds and hundreds of examples of catalysts prepared using those components [listed in the salt patents] that were not efficiency enhancing.” On cross-examination, however, Dr. Conn conceded that while he “imagin[ed]” having seen experiments demonstrating that certain combinations fell within the scope of the salt patents yet failed to yield efficiency enhancing catalysts, he “[could not] recall any specifically.”<sup>9</sup> Given the general and vague nature of these statements, we conclude that the district court did not abuse its discretion when it held that the jury’s verdict of lack of enablement was against the weight of the evidence, and we therefore affirm the court’s decision to grant Union Carbide a new trial on the issue.<sup>10</sup>

## ii. The District Court’s Grant of JMOL in Union Carbide’s Favor on Enablement

We reverse, however, the district court’s decision to convert its grant of a new trial to JMOL in Union Carbide’s favor on the issue of enablement. Under Rule 50(a)(1), a court may grant a party’s motion for JMOL before the case is submitted to the jury if “a party has been fully heard on an issue and there is no legally sufficient evidentiary basis for a reasonable jury to find for that party on that issue.” Fed. R. Civ. P. 50(a)(1). A party who

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Carbide states that it did not rely on the original application filing date for priority. We therefore find Shell’s priority date arguments unconvincing.

<sup>9</sup> The dissent cites to “Union Carbide’s notebooks, which listed hundreds of ineffective catalysts.” *Infra* at 5. At trial defendant adduced evidence concerning failed experiments conducted by the patentee. Appellee, however, has failed to draw our attention to any evidence that the failed experiments fell within the scope of the patent claims, even ignoring the efficiency enhancing limitation. Evidence of unsuccessful experimentation without any link to the claims at issue is not evidence of a lack of enablement.

<sup>10</sup> While the dissent cites *Atlas Powder Co. v. E.I. DuPont de Nemours & Co.*, 750 F.2d 1569, 224 USPQ2d 409 (Fed. Cir. 1984), in support of its enablement analysis, we note that, unlike the claims at issue here, the *Atlas Powder* claims contained no operability limitation. Consequently, the inoperative species there, emulsion blasting agents that failed to work, fell within the scope of the claims. *See id.* at 1572, 224 USPQ at 410. In any event, the materiality of species that do not possess the claimed utility to the enablement inquiry is not an issue here since we reject Shell’s enablement arguments,

fails to move for JMOL at the close of all the evidence, however, will be precluded from moving for JMOL after the verdict. As the Third Circuit stated in Greenleaf:

It is well settled that a party who does not file a Rule 50 motion for judgment as a matter of law at the end of the evidence is not thereafter entitled to have judgment entered in its favor notwithstanding an adverse verdict on the ground that there is insufficient evidence to support the verdict.

174 F.3d at 364 (citing Lowenstein v. Pepsi-Cola Bottling Co., 536 F.2d 9, 11 (3d Cir. 1976)); see also Mallick v. Int'l Bhd. of Elec. Workers, 644 F.2d 228, 233 (3d Cir. 1981) (“It is a firmly entrenched rule that a court may grant a motion for judgment notwithstanding the verdict only when the moving party formally renewed its motion for a directed verdict at the close of all the evidence.”). Here, Union Carbide did not make a motion for JMOL on enablement before the case was submitted to the jury. As such, it was not entitled to move for JMOL on the issue after the verdict. The district court therefore erred as a matter of law when it granted JMOL in Union Carbide’s favor, and we consequently reverse the court’s judgment that the salt patents are not invalid for lack of enablement as a matter of law.

### **b. Invalidity for Obviousness**

#### **i. The District Court’s Grant of a New Trial on Obviousness**

A patent claim is invalid “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.” 35 U.S.C. § 103(a) (2000). All patents, however, are presumed to be valid. Id. § 282. Consequently, a party seeking a judgment that a patent is obvious bears the burden of demonstrating by clear and convincing evidence that the teachings of the prior art would have suggested the claimed subject matter to one of

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including its claim of undue experimentation, on the basis of the insufficiency of the record evidence.

ordinary skill in the art. See Brown & Williamson Tobacco Corp. v. Philip Morris Inc., 229 F.3d 1120, 1124, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000). At trial, Shell argued that the salt patents were rendered obvious by two earlier patents, U.S. Patent 4,007,135 (“Hayden”) and Japanese Patent 56-10750 (“Kokai”). Union Carbide, 163 F. Supp. 2d at 445. While both patents teach the use of mixtures of alkali metals with ethylene oxide catalysts, neither reference suggests the use of “an efficiency-enhancing amount . . . of a mixture of [salts]” as required by the two patents. See id. at 446-49. The district court consequently did not abuse its discretion when it concluded that the jury’s verdict of obviousness was against the weight of the evidence. We therefore affirm the court’s decision to grant Union Carbide’s motion for a new trial on obviousness.

#### **ii. The District Court’s Grant of JMOL in Union Carbide’s Favor on Obviousness**

Union Carbide did not file for JMOL on obviousness before the case was submitted to the jury. Id. at 444. For the reasons discussed above, we therefore reverse the district court’s decision to convert its grant of a new trial on the issue into JMOL in Union Carbide’s favor that the salt patents are not invalid as obvious. See discussion at Section II(B)(3)(a)(ii), supra.

#### **c. Invalidity for Anticipation**

At trial, Shell argued that the salt patents are invalid as anticipated by Hayden, Kokai, or Shell’s own allegedly public use of one of its accused catalysts more than one year prior to the effective filing date of the patents.<sup>11</sup> Union Carbide, 163 F. Supp. 2d at 445. The interrogatories submitted to the jury asked whether Shell had “proven by clear

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<sup>11</sup> Neither party disputes that the date of the CIP application is the priority date for purposes of determining what constitutes prior art. Union Carbide, 163 F. Supp. 2d at 450.

and convincing evidence that the invention described in any asserted claim was anticipated by prior public knowledge or use.” Id. The jury found that it had and returned a verdict of invalidity due to anticipation in favor of Shell. Id. Union Carbide subsequently renewed its pre-verdict motion for JMOL under Rule 50(b). Id. at 444. After examining the record, the district court concluded that the evidence was insufficient to support the jury’s finding of anticipation and consequently granted Union Carbide’s motion. Id. at 451. On appeal, Shell argues that this ruling was erroneous because its anticipation defense was supported by ample record evidence.

As stated above, we review the district court’s grant of JMOL de novo by reapplying the JMOL standard.<sup>12</sup> Southwest Software, 226 F.3d at 1290, 56 USPQ2d at 1167. Under Third Circuit law, “a judgment notwithstanding the verdict may be granted under Fed. R. Civ. P. 50(b) only if, as a matter of law, the record is critically deficient of that minimum quantity of evidence from which a jury might reasonably afford relief.” Trabal v. Wells Fargo Armored Serv. Corp., 269 F.3d 243, 249 (3d Cir. 2001). In order to succeed on its anticipation defense, Shell was required to prove by clear and convincing evidence that every limitation of Union Carbide’s asserted claims was contained, either expressly or inherently, in a single prior art reference. See Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc., 246 F.3d 1368, 1374, 58 USPQ2d 1508, 1512 (Fed. Cir. 2001) (“A claim is anticipated if each and every limitation is found either expressly or inherently in a single prior art reference.” (quoting Celeritas Techs. Ltd. v. Rockwell Int’l Corp., 150 F.3d 1354, 1360, 47 USPQ2d 1516, 1522 (Fed. Cir. 1998))). In other words,

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<sup>12</sup> Because Union Carbide moved for JMOL on the issue of anticipation pursuant to Rule 50(a) before the case was submitted to the jury, it was entitled to renew that motion after the verdict under Rule 50(b). Fed. R. Civ. P. 50(b) (“The movant may renew its [pre-verdict] request for judgment as a matter of law by filing a motion no later than 10 days after entry of judgment . . .”).

Shell bore the burden of demonstrating that there were no differences between Union Carbide's claimed invention and at least one of Shell's asserted prior art references.

We conclude that the district court did not err when it granted JMOL in Union Carbide's favor on the issue of anticipation. As discussed above, neither Hayden nor Kokai includes the "efficiency-enhancing amount . . . of a mixture of [salts]" limitation contained in the asserted salt patents. See discussion at Section II(B)(3)(b)(i), supra. As a matter of law, therefore, neither of these two references anticipates Union Carbide's salt patents. With respect to Shell's asserted prior public use of its own catalysts, Shell introduced the following evidence at trial: (1) the testimony of Dr. Richard Frank Schimbor, the former head of Shell's catalyst business, that when Shell first developed the relevant catalyst, Shell was "out telling everybody, our customers, to be sure to get them interested"; and (2) the testimony of a former Shell employee that she "believe[d] there was one non-Shell customer who also used the catalyst" during the period that it was being commercialized. Union Carbide, 163 F. Supp. 2d at 450-51. Shell offered no corroboration for either assertion. Uncorroborated oral testimony by interested parties "is insufficient as a matter of law to establish invalidity of [a] patent." Finnigan Corp. v. Int'l Trade Comm'n, 180 F.3d 1354, 1370, 51 USPQ2d 1001, 1012 (Fed. Cir. 1999). Shell consequently failed to prove that any of the asserted prior art references anticipated Union Carbide's patents, and we affirm the district court's grant of Union Carbide's motion for JMOL that the salt patents are not invalid as anticipated.

#### **d. Invalidity for Prior Invention**

Before the jury, Shell argued that one of its former employees, Dr. Lauritzen, invented the subject matter of the salt patents before Union Carbide and that the salt patents were therefore invalid under 35 U.S.C. § 102(g)(2). Union Carbide, 163 F. Supp.

2d at 451. The jury returned a verdict in favor of Shell, id., and Union Carbide renewed its pre-verdict motion for JMOL, id. at 444. The court granted Union Carbide's motion, concluding that Shell's evidence of prior inventorship failed as a matter of law. Id. at 453.

Section 102(g) provides that a person is not entitled to a patent if "before such person's invention thereof, the invention was made in this country by another inventor who had not abandoned, suppressed, or concealed it." 35 U.S.C. § 102(g) (2000). An inventor can establish that she was the first to invent under § 102(g) by demonstrating either that she was the first to reduce the invention to practice or that she was the first to conceive of the invention and then, prior to the other party's conception, exercised reasonable diligence in reducing the invention to practice. Id.; see also Griffin v. Bertina, 285 F.3d 1029, 1032, 62 USPQ2d 1431, 1433 (Fed. Cir. 2002). "To prove actual reduction to practice, an inventor must establish that he actually prepared the composition and knew it would work." Estee Lauder Inc. v. L'Oreal, S.A., 129 F.3d 588, 592, 44 USPQ2d 1610, 1613 (Fed. Cir. 1997) (emphasis added). In the instant case, Dr. Lauritzen stated that, even at the time of trial, she did not know whether her catalysts contained cesium salts. Union Carbide, 163 F. Supp. 2d at 452. When asked on cross-examination whether she had ever made any catalysts containing a mixture of cesium salts, she responded, "I do not know because I do not know the form of cesium on the catalyst with certainty." Id. Both the '343 and the '481 patents require a mixture of metal salts including cesium. See '343 patent, col. 32, l. 63-col. 33, l. 9; '481 patent, col. 27, ll. 48-56. Shell therefore failed to prove that Dr. Lauritzen "actually prepared the composition" claimed in Union Carbide's patents, and its priority of invention defense consequently fails as a matter of law. We affirm the district court's decision to grant Union Carbide's motion for JMOL that the salt patents are not invalid for prior inventorship under § 102(g).

### C. Shell's Inequitable Conduct Defense

Prior to the parties' opening statements, the court informed Union Carbide and Shell that, consistent with the court's practice, evidence of inequitable conduct needed to be presented outside the presence of the jury. Union Carbide, 163 F. Supp. 2d at 455. As the court stated, "[i]f 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." Id. Shell failed to do so, id., and the court consequently concluded that Shell had waived inequitable conduct as a defense, denying Shell's renewed motion for JMOL on the issue, id. at 457. The court further held that this ruling rendered Union Carbide's responsive JMOL on the question moot. Id. at 465 n.32.

On appeal, Shell argues that this constituted an abuse of the district court's discretion. Shell asserts that, contrary to the court's stated practice, it did not need to present evidence of inequitable conduct outside the presence of the jury because all of the evidence it offered on the subject was admitted as relevant to other issues. According to Shell, the district court therefore should have reached the merits of Shell's defense, found the salt patents invalid as a result of Union Carbide's inequitable conduct, and on the basis of that finding, granted Shell's motion for exceptional case and attorney fees.

This argument is without merit. Even assuming arguendo that Shell introduced evidence that was relevant to both its validity and its inequitable conduct defenses, this does not change the fact that Shell failed to give notice that it was pursuing the inequitable conduct issue. As the district court stated, "[n]ot only was the court unaware that Shell was mounting an inequitable conduct case, Union Carbide was likewise not aware." Id. at 457. As a result, Union Carbide did not present its own evidence on the issue. Id. In light of

Shell's failure to give notice, we conclude that the district court did not abuse its discretion when it held that Shell waived this defense. We therefore affirm.

### **CONCLUSION**

The district court erred when it construed the claim term "characterizable by an efficiency equation" to mean "determined from the efficiency equation." We therefore reverse the jury's verdict that Shell did not infringe claim 4 of the '243 synergy patent, which was based solely on this erroneous construction, and remand for a determination of infringement in accordance with the correct claim construction. We also reverse the district court's grant of JMOL in Union Carbide's favor that the '243 patent is not invalid as indefinite, obvious, or for lack of enablement. With regard to the '343 and the '481 salt patents, we affirm the district court's construction of the claim term "an efficiency-enhancing amount . . . of a mixture of [salts]," as well as its denial of Union Carbide's motion for a new trial on infringement. We also affirm the district court's grant of Union Carbide's motions for a new trial on enablement and obviousness. We reverse, however, the district court's subsequent decision to enter JMOL in Union Carbide's favor on these two issues. We affirm the district court's grant of JMOL in Union Carbide's favor that the salt patents are not invalid as anticipated or for prior invention. Finally, we affirm the district court's denial of Shell's motion for JMOL on Union Carbide's alleged inequitable conduct and affirm its decision to deny Shell's motion for attorney fees. The decision of the court is therefore

AFFIRMED-IN-PART, REVERSED-IN-PART, and REMANDED.

### **COSTS**

No costs.

United States Court of Appeals for the Federal Circuit

02-1001,-1020

UNION CARBIDE CHEMICALS & PLASTICS TECHNOLOGY CORPORATION  
and UNION CARBIDE CORPORATION,

Plaintiffs-Appellants,

v.

SHELL OIL COMPANY, SHELL CHEMICAL COMPANY,  
and CRI CATALYST COMPANY,

Defendants-Cross Appellants.

MAYER, Chief Judge, dissenting.

Because I believe the district court abused its discretion in granting a new trial on the validity issues because it thought that alleged attorney misconduct prejudiced the verdict, and that the verdict was against the weight of the evidence, I dissent. I would sustain the jury's findings that U.S. Patent Nos. 4,908,343 and 5,057,481, the salt patents, are invalid for lack of enablement.

I

Shell's statements at trial do not suggest that it was reasonably probable that the verdict was adversely influenced. The district court was attentive to the possibility of prejudice and kept tight control over courtroom proceedings. She barred any reference to prior litigation in which Union Carbide had entered into a consent decree acknowledging that some of its catalysts infringed certain Shell patents. The district court summarized Shell's primary comments as (1) "bad act copying" allegations supported by the prior litigation made during opening statements, which were offset by Union Carbide's

allegations that Shell illegally took Union Carbide's invention without permission; (2) two references to the prior litigation made on the fifth and tenth days of trial respectively for which Union Carbide's objections were sustained; and (3) two "copying" comments made during closing arguments with respect to prior invention, which the court had deemed appropriate. Union Carbide Chems. v. Shell Oil Co., 163 F. Supp. 2d 426, 458-64 (D. Del. 2001).

These instances over the course of a twelve-day trial may have been improper, but their cumulation could not reasonably have resulted in a prejudiced determination of invalidity and they do not approach the level of conduct required by Third Circuit precedent for a new trial. See Fineman v. Armstrong World Indus., 980 F.2d 171, 206-07 (3d Cir. 1992) (affirming the grant of a new trial when plaintiff's counsel during summation remarked on his own truthfulness and trustworthiness, referred to facts not in evidence, accused the defense's witnesses of being liars and perjurers, and made disparaging attacks on defense counsel); Draper v. Airco, Inc., 580 F.2d 91, 95 (3d Cir. 1978) (finding a new trial appropriate when plaintiff's counsel during closing argument made repeated inappropriate remarks about the defendant's wealth, inserted his personal opinion, referred to facts not in evidence, and made vituperative and insulting references to defendant's counsel). Moreover, sustaining invalid patents is an inappropriate cure for alleged attorney misconduct.

## II

I would uphold the jury's finding of invalidity of the salt patents for lack of enablement as supported by substantial evidence. A court's determination of enablement is a question of law that we review de novo, but based upon factual findings that we review for substantial evidence. Bio-Tech. Gen. Corp. v. Genentech, Inc., 267 F.3d 1325, 1329, 60 USPQ2d 1430, 1433 (Fed. Cir. 2001). We must determine whether substantial evidence presented at the trial supports the jury's verdict. Id. An enabling specification must teach one of skill in the art how "to make and use the full scope of the claimed invention without 'undue experimentation.'" Genentech, Inc. v. Novo Nordisk, A/S, 108 F.3d 1361, 1365, 42 USPQ2d 1001, 1004 (Fed. Cir. 1997) (quoting In re Wright, 999 F.2d 1557, 1561, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993)) (emphasis added).

In this case, both salt patents claim an extremely large breadth of combinations and permutations of materials. The '343 patent, in claim 1, claims a catalyst containing "an efficiency-enhancing amount . . . of a mixture of (i) a cesium salt of an oxyanion of an element selected from Groups 3through [sic] 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 . . . ." The '481 patent, in claim 1, claims a catalyst containing "an efficiency-enhancing amount . . . 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 the atomic number of 21 to 75 and being from groups 3b through 7b inclusive, of the Periodic Table of the Elements."

The full scope of the claimed mixtures is not enabled by the specifications. See In re Fisher, 427 F.2d 833, 839, 166 USPQ 18, 24 (CCPA 1970) ("[T]he scope of the claims must bear a reasonable correlation to the scope of enablement provided by the specification to persons of ordinary skill in the art."). The patents' specifications list

examples of combinations of the claimed elements that result in efficiency enhancing catalysts. And by using these select examples, one of skill in the art may generate efficiency enhancing catalysts.\* The claims, however, are not limited to these examples and many claimed combinations do not result in efficiency enhancing agents. Contrary to the court's misreading of the record, Dr. Conn, one of Shell's expert witnesses, testified that Union Carbide's laboratory notebooks contain "hundreds and hundreds of examples of catalysts prepared using those components that were not efficiency enhancing."

This court affirms the trial court's decision to overturn the jury verdict of nonenablement by casually dismissing evidence of these nonefficiency enhancing combinations as general and vague and declining to decide whether such evidence is material. But it is error to exclude from the enablement analysis the excessive amount of experimentation that is required to find the right mixture of listed claim limitations, from a major portion of the usable Periodic Table, to produce the efficiency enhancing effect. See Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 336 U.S. 271, 276 (1949) (reinstating a district court decision finding patent claims invalid for being too broad and comprehending more than the invention when the claims contained the term "metallic silicates" and the specification contained only nine metallic silicates which had been proven operative); Durel Corp. v. Osram Sylvania Inc., 256 F.3d 1298, 1306-07, 59 USPQ2d 1238, 1244 (Fed. Cir. 2001) ("If Sylvania had shown that a significant percentage of oxide coatings within the scope of the claims were not enabled, that might have been sufficient to prove invalidity."); Atlas Powder Co. v. E.I. DuPont de Nemours & Co., 750 F.2d 1569, 1576-77, 224 USPQ 409, 414 (Fed. Cir. 1984) ("Even if some of the claimed combinations were inoperative,

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\* The trial court improperly overturned the jury's verdict on this basis. Union Carbide, 163 F. Supp. 2d at 445. To do so, it misconstrued Shell's expert's statement that the '481 patent taught one

the claims are not necessarily invalid. . . . [I]f the number of inoperative combinations becomes significant, and in effect forces one of ordinary skill in the art to experiment unduly in order to practice the claimed invention, the claims might indeed be invalid.”). Union Carbide’s notebooks, which listed hundreds of ineffective catalysts, demonstrate that to generate an efficiency enhancing catalyst under the salt patents requires one of ordinary skill in the art to conduct undue experimentation. The evidence presented at trial leads to but one conclusion, that the jury correctly decided that the salt patents are not enabled. The district court’s action in countermanding the jury contravened Graver Tank, 336 U.S. at 277 (Claims are not to be saved when they overclaim an invention, even if the specification is less inclusive than the claims.).

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of skill in the art to make several cesium-containing catalysts as an admission that the patent was enabled, i.e., that it enabled all the listed possible cesium combinations. Id.