United States Court of Appeals for the Federal Circuit

04-1475, -1512

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

Plaintiffs-Cross Appellants,

v.

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

Defendants-Appellants.

Harry J. Roper, Jenner & Block LLP, of Chicago, Illinois, argued for plaintiffs-cross appellants. With him on the brief were David R. Bennett, Aaron A. Barlow, and Raymond N. Nimrod; Paul M. Smith and Marc A. Goldman, of Washington, DC. Of counsel on the brief was Bruce M. Kanuch, The Dow Chemical Company, of Midland, Michigan.

William C. Slusser, Slusser Wilson & Partridge LLP, of Houston, Texas, argued for defendants-appellants. With him on the brief were Jayme Partridge and Jayne Piana. Of counsel on the brief were John D. Norris and Richard L. Stanley, Howrey LLP, of Houston, Texas. Of counsel were Laura F. Jones, Keith Jaasma and Michael E. Wilson, Slusser Wilson & Patridge LLP, of Houston, Texas.

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

Chief Judge Sue L. Robinson

United States Court of Appeals for the Federal Circuit

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DECIDED: October 3, 2005

Before MAYER, RADER, and PROST, Circuit Judges.

RADER, Circuit Judge.

The United States District Court for the District of Delaware granted final judgment to Union Carbide Chemicals & Plastics Technology Corporation and Union Carbide Corporation (collectively Union Carbide) after a jury found that Shell Oil Company, Shell Chemical Company, and CRI Catalyst Company (collectively Shell) infringed claim 4 of Union Carbide's U.S. Patent No. 4,916,243 (the '243 patent). Union Carbide Chems. & Plastics Tech. Corp. v. Shell Oil Co., No. Civ. 99-CV-274-SLR, Civ. 99-846-SLR, 2004 WL 1305849 (D. Del. June 9, 2004) (Union Carbide III). Because substantial evidence supports the jury verdict, this court affirms that finding. However, because the district court improperly excluded Shell's exportation of catalysts in its damages calculation, this court vacates the damage award and remands.

I.

In 1999, Shell filed a declaratory judgment action in the United States District Court for the Southern District of Texas alleging that Union Carbide's U.S. Patent No. 5,057,481 (the '481 patent), U.S. Patent No. 4,908,343 (the '343 patent), and the '243 patent were invalid, unenforceable, and not infringed. One month later, Union Carbide sued Shell in the United States District Court for the District of Delaware alleging that six of Shell's catalysts infringed those same patents. Union Carbide Chems. & Plastics Tech. Corp. v. Shell Oil Co., 163 F. Supp. 2d 426, 430 (D. Del. 2001) (Union Carbide I). The two cases were consolidated for trial in Delaware. After a twelve day trial, a jury returned a verdict for Shell on issues of infringement and invalidity. Id. Upon appeal, this court affirmed-in-part, reversed-in-part, and remanded. Union Carbide Chems. & Plastics Tech. Corp. v. Shell Oil Co., 308 F.3d 1167 (Fed. Cir. 2002) (Union Carbide II).

In 2003, the district court held a second jury trial on the remanded issues involving only the '243 patent. Union Carbide III, 2004 WL 1305849, at *1. The jury returned a verdict finding that Shell's S-880 and S-882 catalysts directly infringed claim 4 in the production of ethylene oxide (EO). The jury also found that Shell contributorily infringed claim 4 by selling its S-863, S-880 and S-882 catalysts to third parties. Id. Accordingly, the jury awarded $112,198,893 in damages to Union Carbide. The trial court first adjusted that award to $111,212,665 after correcting for a clerical error and later to $153,615,774 for prejudgment interest. Id. at *1, *15 n.19, *20, *22. This damages award, however, did not account for Shell's exportation of catalysts because the district court ruled in limine that 35 U.S.C. § 271(f) damages are not available for process claims, such as claim 4 of the '243 patent. After considering post-trial motions

from both parties, the district court entered a final judgment for Union Carbide and a permanent injunction against Shell, which it stayed pending Shell's appeal to this court. Id. at *22.

Shell appeals the district court's denial of its Judgment as a Matter of Law (JMOL) motions and the damages amount. Union Carbide cross-appeals the district court's holding that 35 U.S.C. § 271(f) does not apply to process claims and the jury verdict finding that Shell's infringement was not willful. This court has jurisdiction under 28 U.S.C. § 1295(a)(1) (2000).

II.

This court described the technology at issue in this case at length in Union Carbide II. See Union Carbide II, 308 F.3d at 1171-73. The district court also explained the technology very well in Union Carbide III. Union Carbide III, 2004 WL 1305849, at *2. In brief, the '243 patent claims improved silver catalysts for the commercial production of EO. Union Carbide III, 2004 WL 1305849, at *2. EO gas is used primarily in the industrial production of ethylene glycol, which is used, in turn, to produce polyester fiber, resin and film. Id. Most of the EO produced each year is converted into monoethylene glycol (MEG). Union Carbide and its parent corporation, Dow Chemical, produce twenty-five percent of the MEG sold domestically. Id. at *2 n.3. Shell is a direct competitor of Union Carbide and Dow Chemical in EO production and MEG sales.

Union Carbide's proprietary process for EO production involves a highly exothermic reaction between ethylene and oxygen occurring between 250 – 300 ^{o}C. '243 patent, col. 12, l. 50-col. 13, l. 30. Before 1971, the ordinary artisan in this field understood that a silver catalyst decreased the reaction temperature and increased

reaction efficiency without consuming or altering the silver itself. Id. at *2. However, no producer managed to increase the reaction efficiency beyond 65 percent. Id. In 1971, scientists discovered that certain alkali metals in small amounts further promoted the efficiency of silver-catalyzed reactions. Id. Union Carbide thus undertook considerable research on catalysts with silver and other alkali metals. This research led to the invention now claimed in the '243 patent.

The '243 patent claims a process for the production of EO with a greater decrease in the reaction temperature than processes using pure silver catalysts. Thus, this new process reduces the formation of oxygen and water byproducts and increases the efficiency of the reaction. '243 patent, col. 8, ll. 39-55. Claim 4, the sole claim at issue in the present appeal, concerns a process involving a catalyst including silver, cesium and lithium. Claim 4 of the '243 patent reads:

> 4. The process of claim 1 wherein said alkali metal is lithium.
>
> 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^{o} C. to 300^{o} 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 m^2/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:

$$\text{efficiency \%} = b_0 + b_1(BG) + b_2(BC_S) + \sum_{1}^{4} b_{3j}\,BA_j + b_4(BG)^2 + b_5(BCs)^2 + \sum_{1}^{4} b_{6j}\,BA_j^2 + b_7\,(BG \bullet \text{BCs})\ \text{[sic]} + (BG)\sum_{1}^{4} b_{8j}\,BA_j + (BCs)\sum_{1}^{4} b_{9j}\,BA_j,$$

where

BA_1 =BRb,
BA_2 =BK,
BA_3 =BNa,
BA_4 =BL_i[sic],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, 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. 61. (emphasis added). Claim 4, as construed by the district court, contains four limitations:

(1) an EO process operated at specific reaction conditions; (2) the catalyst used in the EO process comprises silver in a first amount, cesium in a second amount, and lithium in a third amount; (3) the efficiency obtainable from the EO process using the catalyst is greater than the efficiency of a process using (a) a second catalyst containing silver in the first amount and cesium in the second amount (but no lithium) and (b) a third catalyst

> containing silver in the first amount and lithium in the third amount (but no cesium), when operated in the same EO production system (the "comparison test"); and (4) the combination of silver, cesium and lithium is characterizable by the efficiency equation set forth in claim 1 (the "characterizable test").

Union Carbide III, 2004 WL 1305849, at *3.

At trial, Union Carbide provided evidence showing that 58 samples of "Shell" catalysts met the comparison and characterizable limitations of claim 4. Specifically, Union Carbide's expert witness, Professor Haller, tested samples sold by Shell commercially and catalysts that he produced by following recipes detailed in Shell's internal documents. Shell now challenges the sufficiency of this evidence in proving infringement of claim 4. Shell contends that, inter alia: (1) Union Carbide did not conduct its tests of Shell's catalysts at the "same conversions" of ethylene and oxygen to EO gas as specified by the '243 patent; (2) Union Carbide did not vary silver in the desired set of experiments; and (3) Union Carbide did not conduct the "comparison test" in the "same ethylene production system," nor did they conduct the "characterizable test" in the "same ethylene production system," but instead conducted each test in an EO production system different than Shell's. Shell also contends that, if Union Carbide's tests are sufficient to prove infringement, the claims are invalid.

III.

"The grant or denial of a motion for judgment as a matter of law is a procedural issue not unique to patent law, reviewed under the law of the regional circuit in which the appeal from the district court would usually lie." Summit Tech., Inc. v. Nidek Co., 363 F.3d 1219, 1223 (Fed. Cir. 2004). Under the law of the United States Court of Appeals for the Third Circuit, this court exercises plenary review over an order denying

JMOL. Microvote v. Montgomery County, 320 F.3d 440, 446 (3d Cir. 2003). The Third Circuit grants motions for JMOL only if, "viewing the evidence in the light most favorable to the nonmovant and giving it the advantage of every fair and reasonable inference, there is insufficient evidence from which a jury reasonably could find liability." Id. (citing Lightning Lube, Inc. v. Witco Corp., 4 F.3d 1153, 1166 (3d Cir. 1993)).

While claim construction is a question of law, see Cybor Corp. v. FAS Techs. Inc., 138 F.3d 1448, 1451 (Fed. Cir. 1998) (en banc), infringement, whether literal or under the doctrine of equivalents, is a question of fact which this court reviews for substantial evidence, see Bai v. L & L Wings, Inc., 160 F.3d 1350, 1353 (Fed. Cir. 1998); Optical Disc. Corp. v. Del Mar Avionics, 208 F.3d 1324, 1333-34 (Fed. Cir. 2000).

A finding of willful infringement may qualify a case as exceptional under 35 U.S.C. § 285 (1952), thereby allowing a party to obtain enhanced damages. "This court reviews a district court's exceptional case finding for clear error." Imonex Servs., Inc. v. W.H. Munzprufer Dietmar Trenner Gmbh, LLC, 408 F.3d 1374, 1378 (Fed. Cir. 2005) (citing Pharmacia & Upjohn Co. v. Mylan Pharms., Inc., 182 F.3d 1356, 1359 (Fed. Cir. 1999)). The trial judge has discretion to increase damages for exceptional cases; hence, a district court's refusal to award increased damages will not be overturned absent an abuse of that discretion. Modine Mfg. v. Allen Group, Inc., 917 F.2d 538, 543 (Fed. Cir. 1990).

In reviewing a district court's damages award, "the amount of a prevailing party's damages is a finding of fact on which the plaintiff bears the burden of proof by a preponderance of the evidence. . . . However, certain subsidiary decisions underlying

a damage theory are discretionary with the court, such as, the choice of an accounting method of determining profit margin . . . or the methodology for arriving at a reasonable royalty." SmithKline Diagnostics, Inc. v. Helena Lab. Corp., 926 F.2d 1161, 1164 (Fed. Cir. 1991). "A jury's decision with respect to an award of damages 'must be upheld unless the amount is 'grossly excessive or monstrous', clearly not supported by the evidence, or based only on speculation or guesswork.'" State Contracting & Eng'g Corp. v. Condotte Am., Inc., 346 F.3d 1057, 1072 (Fed. Cir. 2003) (quoting Brooktree Corp. v. Advanced Micro Devices, Inc., 977 F.2d 1555, 1580 (Fed. Cir. 1992)). Finally, "[t]his court reviews questions of statutory interpretation without deference." U.S. Steel Group v. United States, 225 F.3d 1284, 1286 (Fed. Cir. 2000).

IV.

Shell challenges the sufficiency of the evidence supporting the jury verdict that Shell directly and contributorily infringes claim 4 of the '243 patent. Union Carbide III, 2004 WL 1305849, at *1. Shell initially challenged the sufficiency of the evidence below in a motion for JMOL or, in the alternative, for a new trial, after the jury returned its verdict against Shell. Id. at *5. The district court denied Shell's motion.

As a threshold matter, this court must decide whether Shell waived this issue by failing to timely object to the district court's jury instruction under Fed. R. Civ. P. 51. Union Carbide contends that Shell only objected after close of evidence and completion of the jury instruction charge conference. Because Union Carbide construes Shell's non-infringement arguments as claim construction issues, Union Carbide considers Shell to have waived these arguments. Union Carbide cites instances that this court has found waiver of claim construction issues. See Eli Lilly & Co. v. Aradigm Corp., 376

F.3d 1352, 1360 (Fed. Cir. 2004); Hewlett-Packard Co. v. Mustek Sys., Inc., 340 F.3d 1341, 1321 (Fed. Cir. 2003).

Although often difficult to distinguish claim construction and infringement, this court's case law requires the distinction. See Beckson Marine, Inc. v. NFM, Inc., 292 F.3d 718, 724 (Fed. Cir. 2002) (commenting that "[a]fter claim construction, the infringement inquiry shifts to a comparison of the claim with the allegedly infringing device.") (citing Kemco Sales, Inc. v. Control Papers Co., 208 F.3d 1352, 1359, 54 USPQ2d 1308, 1312 (Fed. Cir. 2000) (emphasis added)); KCJ Corp. v. Kinetic Concepts, Inc., 223 F.3d 1351, 1358 (Fed. Cir. 2000) ("Literal infringement of a claim occurs when every limitation recited in the claim appears in the accused device, i.e., when 'the properly construed claim reads on the accused device exactly.'") (quoting Amhil Enters., Ltd. v. Wawa, Inc., 81 F.3d 1554, 1562 (Fed. Cir. 1996) (emphasis added)); Markman v. Westview Instruments, Inc., 517 U.S. 370 (1996) (holding that construing patent claims is a question of law for the judge, separate from determining whether infringement occurred which is a question of fact to be submitted to the jury). Contrary to Union Carbide's assertions, this court construes Shell's arguments as most relevant to non-infringement, rather than claim construction. Shell, in essence, challenges the sufficiency of the evidence supporting a finding of infringement. Nonetheless, in at least one of Shell's challenges to the infringement verdict, its argument questions the meaning of words in the district court's jury instructions. Therefore, even with respect to this infringement issue (as opposed to claim construction issues), this court assesses the timeliness of Shell's objections under Rule 51.

Rule 51 is not unique to patent cases and, thus, regional circuit law applies. Ecolab Inc. v. Paraclipse, Inc., 285 F.3d 1362, 1369 (Fed. Cir. 2002). Under Third Circuit law, a party need only lodge a sufficiently specific objection before jury deliberations to preserve issues for appeal. See Alexander v. Riga, 208 F.3d 419, 426 (3d Cir. 2000); Waldorf v. Shuta, 896 F.2d 723, 739-40 (3d Cir. 1990).

The record shows that Shell requested clarifying instructions on the three claim terms at issue on Monday morning, November 3, 2003, before the judge's delivery of instructions to the jury. During a conference between counsel from both parties and the judge out of the jury's presence, Mr. Norris, counsel for Shell, informed the district court that he "would like to just read these [issues] into the record for purposes of preserving issues for appeal." After the district court allowed Mr. Norris to make his record, he objected to the jury instructions by requesting insertion of the following language:

> [1] [B]ecause the '243 patent defines conversion as ethylene conversion, the efficiency must be determined at the same ethylene conversion achieved in the accused commercial ethylene oxide production system. . . . .
> [2] Once the commercial ethylene oxide production system is defined, thereby fixing the specific reaction conditions, the specific catalyst support characteristics and the specific silver deposition method to precise values, that same ethylene oxide production system must be duplicated in its entirety by the laboratory or experimental conditions and parameters. . . . .
> [3] In Claim 4, the limitation, quote, independent variable silver cesium and alkali metal, close quote, requires testing and a design set of experiments where the concentrations of silver, cesium and lithium are varied across a range of values.

(Alterations added.) Thereafter, the district court acknowledged Shell's arguments.

Jury deliberations occurred after the judge gave instructions to the jury and a verdict was reached on the same day. Because Shell sufficiently raised specific

objections before jury deliberations, Shell did not waive its objections to the sufficiency of the evidence on appeal.

V.

Shell asserts that Union Carbide did not show that any of Shell's catalysts provide an efficiency of EO manufacture that is greater than the efficiencies obtainable using (a) a second catalyst containing silver and cesium (but no lithium) and (b) a third catalyst containing silver and lithium (but no cesium), in the same ethylene oxide production system. Specifically, Shell notes that the "comparison test" in the claims specifically calls for the efficiency comparison using the same ethylene oxide production system, including the same conversions. Shell contends "conversion" equates to "ethylene conversion" and thus incorporates a specific formula for ethylene conversion from U.S. Patent No. 3,420,784 (the '784 patent):

$$\text{Percent conversion} = \frac{\text{percent } C_2H_4 \text{ (feed)} - \text{percent } C_2H_4 \text{ (effluent)}}{\text{percent } C_2H_4 \text{ (feed)}} \times 100$$

'784 patent, col. 3, ll. 25-27. Because Union Carbide's expert witness did not use this formula in his tests, Shell asserts that this testing does not prove infringement of the comparison limitation of the claims. However, Shell's argument mischaracterizes the '243 patent's disclosure of acceptable techniques for comparing catalyst efficiencies.

The '243 specification teaches that one "convenient measure of activity, i.e., the degree of conversion of reactant to product per unit time, is the temperature required to obtain either a fixed ethylene oxide production or to achieve a chosen level of mole percent ethylene (or oxygen) conversion." '243 patent, col. 11, ll. 16-22 (emphasis added). Thus, Union Carbide's expert, Professor Haller, applied a test expressly approved by the patent specification. Professor Haller determined catalyst efficiency by

monitoring the temperature required to obtain a fixed 1% EO output (a higher temperature for a given output indicates a lower efficiency). This measure for catalyst efficiency yielded results placing Shell's catalysts squarely within this claim limitation. The trial format gave Shell the opportunity to challenge the accuracy of Professor Haller's results by conducting other tests or by cross-examining Professor Haller. In any event, as an evidentiary matter, Professor Haller's tests followed the directions of the patent specification. The record thus contains sufficient evidence to support the jury verdict of infringement of the comparison limitation.

VI.

Shell asserts that the record does not show that Shell's catalysts are characterizable by the efficiency equation set forth in claim 1, i.e., the "characterizable test." Shell argues that the "characterizable test" requires variation of each independent variable – silver, cesium and lithium – in the same ethylene oxide production system. Because Union Carbide's expert witness did not vary silver in his experiments, Shell asserts that his testing cannot show infringement. These arguments, however, overlook both the permissive meaning of the term "variable" and this court's construction of the efficiency equation in Union Carbide II.

The claim language does not require variation of all three of the components. The claim uses the language "independent variables, silver, cesium, and alkali metal." The word "independent" means that each variable is free to operate without regard to the others. In other words, the concentration of the silver component can be set at and maintained at any value, including zero. Thus, the claims permit the variation of the silver component, but do not mandate silver variation. Indeed, the specification makes

this explicit: "The value of some of the coefficients of the equation may be zero" when deriving the "synergistic binary alkali metal combinations of the invention." '243 patent, col. 8, l. 56-col. 9, ll. 23-4.

Furthermore, this court in Union Carbide II clarified that "characterizable by an efficiency equation" in claim 1 "covers those catalysts that are described by the efficiency equation" or "capable of being described by an efficiency equation." Union Carbide II, 308 F.3d at 1178-79. In other words, the "characterizable test" is a "descriptive tool that defines the scope of the invention." Id. at 1178. The invention's improvement over the prior art is the addition of new synergistic concentrations of alkali metals to known concentrations of silver. This claim captures this aspect of the invention in the "characterizable test." This important test, however, does not require variation of what was already known (i.e., silver) in prior art catalysts or an accused catalyst. Union Carbide II's construction requires tests that vary at least the concentrations of the alkali metals of cesium and lithium. Professor Haller's experiments made these variations. Thus, the record contains evidence sufficient to meet the standards of the "characterizable test."

In a related argument, Shell asserts that, if Professor Haller's test conditions and procedures do satisfy the "characterizable by an efficiency equation" limitation, then the '243 patent is anticipated under 35 U.S.C. § 102(b) by U.S. Patent No. 4,212,772 (the '772 patent). Notably, however, the '772 patent does not disclose use of lithium-based catalysts in the claimed continuous process for the production of EO with carbon-dioxide in the feed. In addition, the admitted expert reports suggest that the '772 patent's catalyst does not meet the characterizable test as construed by the court.

Thus, the ’772 patent does not clearly anticipate claim 4 as argued by Shell. See Celeritas Tech., Ltd., v. Rockwell Int'l Corp., 150 F.3d 1354, 1361 (Fed. Cir. 1998) (“[A] claim is anticipated if each and every limitation is found either expressly or inherently in a single prior art reference.”).

VII.

In its final non-infringement argument, Shell asserts that Union Carbide did not test Shell’s catalysts in the same ethylene production system as used by Shell, thus lacking evidence of infringement of this claim limitation. Rather, Professor Haller conducted his tests in one EO production system that was representative of all of Shell’s 69 accused processes (i.e., an approximation of the entire set of processes that does not match any one particular Shell process). Shell argues this “representative” testing is inadequate because representative testing was disclaimed during prosecution and does not “define” Shell’s system as required by the district court’s jury instructions.

This argument springs from the way Shell construes the term “define” in the district court’s jury instruction. The relevant jury instruction reads:

> “The same ethylene oxide production system.” The file wrapper and patent describe an experimental procedure whereby, once “the conditions and parameters” for a particular ethylene oxide production system are defined, a composite design set of experiments are carried out from which the synergistic combinations are determinable. . . . Therefore, the phrase “same ethylene oxide production system” is construed to mean the laboratory or experimental “conditions and parameters” which define the ethylene oxide production system which ultimately will be used commercially.

(Emphasis added.)

Shell advances the position that “define” means that the laboratory conditions must match the parameters for each of the 69 accused commercial processes. In other

words, Union Carbide must conduct 69 tests, each test matching the parameters in a corresponding accused process. However, the claim language does not specify any particular form of testing – either that contemplated by Shell or the representative testing conducted by Professor Haller. The district court instead explicitly noted that the claims did not require a test matching each of Shell's commercial processes. Union Carbide III, 2004 WL 1305849, at *6 (holding the claims "do not require that the specific reaction conditions of each commercial process be tested, only that the laboratory conditions and parameters define the process ultimately used.") (emphasis added). Because the claim does not require an exact match to the accused processes, Union Carbide had only an obligation to show that its test parameters sufficiently covered the range of conditions in each of the 69 accused commercial processes. As explained by Professor Haller, his tests did precisely that:

> We, obviously, can [not] test every batch of Shell catalyst that was ever made, so I wanted to test it under conditions that would define the whole range of commercial conditions. Not all of them, a specific, particular set that represented commercial conditions and would be applicable. That is, the relative testing, not the absolute, the relative testing would be applicable.

Even Shell uses a single representative set of experimental conditions to test their commercial catalysts' efficiencies and warrant these catalysts based on those laboratory tests, *not* based on individual tests for each of their 69 processes.

Because the claim language does not require a particular form of testing, this inquiry is not a claim construction question, which this court reviews de novo. Rather, this court reviews this inquiry as a question of fact. Does the record contain adequate evidence to support the jury's verdict that Professor Haller's laboratory or experimental conditions and parameters did, in fact, define the system ultimately used by Shell? Bai,

160 F.3d 353. Because Professor Haller's testimony supports the conclusion that his tests represented each commercial system, substantial evidence supports the jury's determination of infringement.

VIII.

On the question of the royalty computation, the district court admitted evidence regarding the impact of Shell's infringing sales on Union Carbide Chemicals, the parent of a holding company that holds the title to the '243 patent. Union Carbide Corporation is the parent corporation of the '243 patent's sole assignee, Union Carbide Chemicals & Plastics Technology Corporation, a technology holding company that does not make, use or sell EO. Therefore, Shell asserts that Union Carbide Corporation is merely a non-exclusive licensee of the '243 patent that "suffers no legal injury from infringement." Ortho Pharm. Corp. v. Genetics Institute, Inc., 52 F.3d 1026, 1031 (Fed. Cir. 1999). Based on this assertion, Shell fears that evidence about the impact of Shell's infringing sales on Union Carbide Chemicals effectively allowed the holding company to seek damages for Union Carbide Chemicals' lost profit.

To the contrary, unlike the entities in Ortho Pharm., Union Carbide Corporation is not merely a non-exclusive licensee of the '243 patent. In Ortho Pharm., the non-exclusive licensee was a pharmaceutical company given rights to sell a drug bio-engineered by another pharmaceutical company. Id. at 1028-30. The licensing transaction in that case was conducted at arm's length and involved no ownership relationship between the two companies. Id. In the present case, however, Union Carbide Corporation wholly owns Union Carbide Chemicals & Plastics Technology Corporation. Their relationship thus goes far beyond a licensor/licensee arrangement.

Hence, Ortho's holding does not apply in this setting where different business realities stem from the partnership of these related entities.

Because of the genuine relationship between these companies, the district court decision properly permitted consideration of these sales. Simply put, the holding company would not enter any negotiation without considering the competitive position of its corporate parent, Union Carbide Corporation. Shell is a direct competitor of Union Carbide Corporation in EO production and MEG sales. Therefore any hypothetical negotiation with the holding company must necessarily include the reality that the economic impact on the Union Carbide Corporation would weigh heavily in all decisions. The district court correctly recognized that the hypothetical negotiation model would thus properly include these circumstances. Consequently, the district court did not abuse its discretion in admitting this evidence for purposes of calculating a reasonable royalty.

In addition, the district court properly permitted the jury to consider damages evidence about Shell's profits for MEG production. In this technology, increased EO production directly increases MEG production. With this linkage, this court perceives no error in permitting the jury to factor evidence of bundling and convoyed sales into a determination of the scope of the royalty base. Deere & Co. v. Int'l Harvester Co., 710 F.2d 1551, 1559 (Fed. Cir. 1983) (authorizing such an approach as "eminently reasonable"). In fact, the district court found that the most common and profitable form of EO is MEG. Union Carbide III, 2004 WL 1305849, at *5 n.3. Thus, the district court did not abuse its discretion in admitting evidence of convoyed MEG sales for calculating a reasonable royalty. Accordingly this court affirms the district court's damages award.

IX.

On the cross appeal, Union Carbide asserts that the district court erred as a matter of law by ruling in limine that 35 U.S.C. § 271(f) "is not directed to process claims." In doing so, the court prohibited Union Carbide from submitting evidence of Shell's foreign sales for the purpose of recovering additional damages under 35 U.S.C. § 271(f)(2). This prohibition was in error.

Section 271(f) of title 35 is generally directed at the exportation, from the United States, of components of patented inventions. Specifically, § 271(f)(2) states:

> (2) Whoever without authority supplies or causes to be supplied in or from the United States any component of a patented invention that is especially made or especially adapted for use in the invention and not a staple article or commodity of commerce suitable for substantial non-infringing use, where such component is uncombined in whole or in part, knowing that such component is so made or adapted and intending that such component will be combined outside of the United States in a manner that would infringe the patent if such combination occurred within the United States, shall be liable as an infringer.

35 U.S.C. § 271(f)(2) (2000) (emphasis added). This case again questions the meaning of the phrase "any component of a patented invention" in the statute. In other words, does this phrase apply to components used in the performance of patented process/method inventions? Eolas Techs. v. Microsoft Corp., 399 F.3d 1325, 1339 (Fed. Cir. 2005) recently answered this question in the affirmative, holding that *every* component of *every* form of invention deserves the protection of 35 U.S.C. § 271(f); i.e., that "components" and "patented inventions" under § 271(f) are not limited to physical machines. In Eolas, this court stated:

> Section 271(f) refers to "components of a patented invention." This statutory language uses the broad and inclusive term "patented invention." Title 35, in the definitions section, defines "invention" to mean "invention or discovery" - again broad and inclusive terminology. 35 U.S.C. § 100(a)

> (2000). The next section in Title 35, section 101, explains that an invention includes "any new and useful process, machine, manufacture or composition of matter."

Id. at 1338-39. Thus, as Eolas explained, the statute makes no distinction between patentable method/process inventions and other forms of patentable inventions.

Moreover, Eolas and this case featured similar facts. In Eolas, Microsoft exported a master computer disc with program code that caused a computer to perform various method steps. See U.S. Patent No. 5,838,906, col. 17, ll. 58-col. 18, ll. 30. Thus, both this case and Eolas feature the exportation of a component (i.e., a computer disc with program code in Eolas and a catalyst in this case) used in the performance of a patented process or method (i.e., the method steps executed by the computer in response to the computer readable program code in Eolas and the commercial production of EO in this case). In that setting, Eolas applied § 271(f) to Microsoft's exported component. Similarly, § 271(f) applies to Shell's exportation of catalysts (i.e., a "component") used in the commercial production of EO abroad (i.e., a "patented invention").

This court has recently interpreted § 271 in two other cases. See AT&T Corp. v. Microsoft Corp., 414 F.3d 1366 (Fed. Cir. 2005); NTP, Inc. v. Research In Motion, Ltd., 418 F.3d 1282 (Fed. Cir. 2005). Because AT&T concluded that § 271(f) applied to the exportation of components ultimately used abroad, its reasoning supports application of § 271 to the facts of this case. See AT&T, 414 F.3d at 1368 (applying § 271(f) to the exportation of a "master" computer readable disc that was further copied abroad, with the copies installed as software on assembled computers). This case, however, presents an even stronger basis for applying § 271(f) because Shell supplies all of its

catalysts from the United States directly to foreign affiliates. Shell's foreign affiliates do not copy these catalysts and use the copies in a foreign process, but instead use the catalysts supplied by Shell directly in their processes.

Unlike AT&T, NTP did not find that § 271(f) applied. However, NTP involved facts that differ in important respects from the facts in this case. Specifically, NTP involved the sale of wireless handheld devices and supporting software for a wireless email network. NTP, 418 F.3d at 1289-90. Research In Motion (RIM) sold wireless handheld devices in the United States. When the owners of those devices traveled abroad, those devices were used outside of the United States; otherwise, those devices were used in the United States. This court in NTP considered whether use of these domestic devices with a system partially operating abroad constituted infringement under § 271(f). Id. The NTP court answered this question in the negative:

> While it is difficult to conceive of how one might supply or cause to be supplied all or a substantial portion of the steps of a patented method in the sense contemplated by the phrase "components of a patented invention" in section 271(f), it is clear that RIM's supply of the BlackBerry handheld devices and Redirector products to its customers in the United States is not the statutory "supply" of any "component" steps for combination into NTP's patented methods.

Id. at 1322. Under the facts of NTP, this court declined to apply § 271(f) when RIM itself did not supply any component to a foreign affiliate. This court in NTP also affirmed a finding of infringement under § 271(a) for RIM's domestic sales of devices (BlackBerries) used in the process. Id. at 1316-17. Thus, this court in NTP declined to authorize additional damages for NTP under § 271(f).

NTP is different from this case because Shell supplies catalysts from the United States directly to foreign customers. Because Shell supplies these catalysts directly to its foreign affiliates, this court does not face another situation involving the

domestic sale of a component being used, in part, outside the United States. Shell's domestic sales are separately covered by the district court's present damages calculation. As such, Eolas, a case more factually analogous and earlier in time than NTP, governs this case.

In brief, because § 271(f) governs method/process inventions, Shell's exportation of catalysts may result in liability under § 271(f). Accordingly, the district court abused its discretion in excluding Shell's exportation of catalysts as part of its damages award. This court remands this case to the district court for additional findings on Shell's potential liability under 35 U.S.C. § 271(f).

X.

The cross appeal also questions the district court's denial of Union Carbide's motion for JMOL that Shell willfully infringed the '243 patent. Specifically, Union Carbide contends that Shell became aware of the '243 patent shortly after issuance, but continued to produce EO in an infringing process without ever obtaining a formal opinion of counsel. Thus, according to Union Carbide, the undisputed facts demonstrate Shell willfully infringed the '243 patent. This argument overstates the facts in the record before the district court.

This court has already declined to draw a negative inference from a party's failure to obtain a formal opinion of counsel after it becomes aware of an issued patent. See Imonex Serv., Inc. v. W.H. Munzprufer Dietmar Trenner GmbH, 408 F.3d 1374, 1378 (Fed. Cir. 2005) (citing Knorr-Bremse Systeme Fuer Nutzfahrzeuge GmbH v. Dana Corp., 383 F.3d 1337, 1342 (Fed. Cir. 2004) (en banc)). Thus, Shell's decision to proceed without an opinion of counsel does not affect the jury verdict in this case.

Moreover, the record shows that Shell was reasonable in its response to the '243 patent. Shell first became aware of the '243 patent when Dr. Clendenen, an in-house patent attorney, discovered the patent as part of a routine monitoring of recently issued patents in the EO catalyst field. The record shows that Dr. Clendenen, a Ph.D. chemical engineer and licensed patent attorney, interpreted the claims as requiring a specific efficiency equation for development of the catalyst in the claimed process. Because Shell did not make catalysts with this specific efficiency equation, Dr. Clendenen concluded that Shell had no reason to fear infringement. The district court at first adopted Dr. Clendenen's reading of the patent which was later rejected by this court. Nonetheless this record suggests that Dr. Clendenen's analysis was not entirely implausible. Accordingly, Shell did not engage in the kind of egregious and reckless conduct that warrants a willfulness finding. Imonex Servs., 408 F.3d at 1377 ("Willfulness requires a showing that the totality of the circumstances evince the egregious conduct that constitutes willful infringement.") (citations omitted). In sum, substantial evidence supports the jury verdict.

XI.

In conclusion, because substantial evidence supports the jury verdicts of infringement and no willfulness, this court affirms those verdicts. However, because the district court erred in concluding § 271(f) does not apply to process claims, this court finds it abused its discretion in excluding Shell's exported catalysts as part of its damages calculation. The case is remanded to the district court for a new determination of damages.

COSTS

Each party shall bear its own costs.

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