United States Court of Appeals for the Federal Circuit

FRANS NOOREN AFDICHTINGSSYSTEMEN B.V., AND STOPAQ B.V.,
Plaintiffs-Appellants,

v.

STOPAQ AMCORR INC., doing business as Amcorr Products and Services, AND DOLPHIN SEALANTS, LLC,
Defendants-Appellees.

2013-1200

Appeal from the United States District Court for the Southern District of Texas in No. 10-CV-3150, Judge Lynn N. Hughes.

Decided: February 21, 2014

GREGORY A. CASTANIAS, Jones Day, of Washington, DC, argued for plaintiffs-appellants. With him on the brief were JOSEPH M. BEAUCHAMP and H. ALBERT LIOU, of Houston, Texas.

JOHN R. KEVILLE, Winston & Strawn LLP, of Houston, Texas, argued for defendants-appellees. With him on the brief was DUSTIN J. EDWARDS. Of counsel on the brief was RICHARD L. STANLEY, of Houston, Texas.

Before RADER, *Chief Judge,* TARANTO, and CHEN, *Circuit Judges.*

TARANTO, *Circuit Judge*.

The district court granted summary judgment of non-infringement. We conclude that the district court made errors in at least one claim construction underlying its non-infringement judgment. We vacate the judgment and remand for further proceedings.

BACKGROUND

Frans Nooren Afdichtingssytemen B.V. owns U.S. Patent No. 5,898,044, entitled "Use of a Preparation for Insulation/Sealing and Coating Purposes and Method for Sealing Manhole Covers." The '044 patent discloses a composition used for insulating and protecting substrates—for example, manhole covers, underground tanks, pipes, and cable sleeves—from corrosion, water ingress, and mechanical stresses. '044 patent, col. 1, lines 6-14; *id.*, col. 4, line 63, through col. 5, line 2. Independent claim 1 of the '044 patent reads:

> [a] shaped article comprising a substrate having on at least one portion of at least one surface a coating composition comprising an apolar, non-thermosetting fluid polymer having a glass transition temperature lower than -20° C. and a surface tension of less than 40 mN/m at a temperature above its glass transition temperature, and *a filler comprising a plurality of fractions each comprising different size particles, and wherein said different fractions have different particle size distributions*.

'044 patent, col. 8, lines 10-18 (emphasis added). The '044 patent specification explains the following about fillers:

> The preparation according to the invention can contain one or more fillers. Said fillers can be of organic or inorganic nature. Examples of inorganic [*sic*] fillers are polyvinyl chloride, polyethene, polypropene, polyisoprene and rubber. Examples of inorganic fillers are inorganic minerals, salts and oxides, for example chalk, boron sulphate, aluminium oxide, silicon dioxide, ground quartz, glass, talc, slate, bentonite and the like. Preferably, a mixture of coarse and fine particles, in a specific mixing ratio, of one or more fillers is used. The rheological characteristics of the preparation according to the invention can be controlled by means of the amount of filler. According to the invention, it is therefore preferable that the fillers comprise one or more fractions, each fraction having a different particle size and a different particle size distribution. In particular, the fillers comprise at least one fraction having a particle size of 0.1 μm to 1500 μm.

Id., col. 3, line 55, through col. 4, line 4. The specification adds that fillers can be "swellable or non-swellable" and can have "a low or a high density." *Id.*, col. 4, lines 5-12.

The '044 patent is licensed exclusively to Stopaq B.V., a Dutch company that designs and manufactures coatings and sealants that exhibit both viscous and elastic properties (*i.e.*, visco-elasticity) and are designed for corrosion protection and waterproofing. Kleiss & Co. B.V., a Dutch company, manufactures similar products that prevent corrosion and protect against leaks. One of these products, ViscoWrap, contains a mix of polybutene, polypropylene, and aluminum trihydrate. EZ Wrap and Hippo Patch, also manufactured by Kleiss, are products that contain a mix of polybutene, polypropylene, and calcium carbonate.

In the United States, ViscoWrap and EZ Wrap are distributed by Amcorr Products and Services, Inc., and Hippo Patch is distributed by Dolphin Sealants LLC (the two companies collectively, "Amcorr"). On August 24, 2010, Kleiss and Amcorr filed a declaratory judgment action against Nooren in the Netherlands seeking a declaration that their products, including ViscoWrap, EZ Wrap, and Hippo Patch, do not infringe the '044 patent. On August 31, 2010, Nooren brought the present action against Amcorr in the United States District Court for the Southern District of Texas, alleging infringement of the '044 patent. Amcorr asserted no counterclaims but did assert affirmative defenses of non-infringement and invalidity.

Upon the parties' joint request, the district court proceeded directly to entertain cross-motions for summary judgment on infringement. Accepting that the polybutene in the accused products met the claim's "fluid polymer" requirements—the specification itself names poly(1-butylene), or polybutene, as a suitable fluid polymer, '044 patent, col. 3, lines 6-10—the parties agreed to focus on the phrase "a filler comprising a plurality of fractions each comprising different size particles, and wherein said different fractions have different particle size distributions" in claim 1, which is the only independent claim in the '044 patent. The court did not conduct a separate proceeding, or receive separate papers, on the proper construction of that filler/fractions limitation.

It is undisputed that, for a product to come within the limitation, it must contain "a filler" that itself includes at least two "fractions" (having certain properties). Nooren contended that the limitation is met by the combination of polypropylene and aluminum trihydrate (for one accused product) and by the combination of polypropylene and calcium carbonate (for the others). In arguing that the polypropylene in the accused products is one of the fractions of the "filler," it noted that the specification identi-

fies polypropylene ("polypropene") as a possible filler. '044 patent, col. 3, line 58. As far as appears, Nooren has not argued that the polypropylene in the accused products itself contains the required plurality of "fractions"; thus, even if polypropylene counts as a fraction, the other claim-required "fraction" has to come from the aluminum trihydrate (for one product) or calcium carbonate (for the others). Nooren did contend, however, that the accused products meet the filler/fractions limitation even if one disregards the polypropylene. Specifically, Nooren argued that each of the aluminum trihydrate and calcium carbonate in the accused products—each undisputedly a "filler"—itself contains two or more "fractions" with the required properties.

Amcorr denied that polypropylene could help satisfy the limitation. First, it argued, all of the "fractions" of any given filler must be of the same material; as a result, polypropylene—not itself containing more than one "fraction"—could not supply a second "fraction" to add to the aluminum trihydrate or calcium carbonate. Second, Amcorr argued, polypropylene in the accused products is not a "filler" at all. Having thus sought to exclude polypropylene from relevance, Amcorr completed its non-infringement argument by denying that either aluminum trihydrate or calcium carbonate itself contains at least two "fractions" having the specified properties.

On January 4, 2013, the district court issued an opinion and order granting summary judgment of non-infringement in favor of Amcorr. *Frans Nooren Afdichtingssytemen BV v. Stopaq Amcorr Inc.*, No. H-10-3150 (S.D. Tex. Jan. 4, 2013), ECF No. 55 ("*District Court Opinion*"). The opinion does not announce full constructions of all of the significant terms of the filler/fractions limitation. It does, however, rely on certain constructions in agreeing with Amcorr. First, it adopts both of Amcorr's grounds for concluding that polypropylene cannot help meet the limitation. *Id.* at 2, 3. Second, it adopts

Amcorr's position that neither the aluminum trihydrate nor the calcium carbonate meets the specific requirements for a plurality of "fractions." *Id.* at 2. Based on those conclusions, the court found no infringement as a matter of law. *Id.* at 3.

The court entered an amended final judgment on January 31, 2013. Nooren appeals. We have jurisdiction under 28 U.S.C. § 1295(a)(1).

DISCUSSION

Nooren challenges the district court's conclusions and the constructions on which they rest. We review the district court's claim constructions and its grant of summary judgment de novo. *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1451 (Fed. Cir. 1998); *Honeywell Int'l, Inc. v. ITT Indus., Inc.*, 452 F.3d 1312, 1317 (Fed. Cir. 2006).

A

1

The district court's principal ground for holding that polypropylene in the accused products cannot help to meet the limitation at issue is a claim construction—that "a filler" in the '044 patent can contain only "one material." *District Court Opinion* at 2; *id.* ("Nooren's patent limits its infringement claims to single-material mixtures."); *id.* at 3 ("the patent does not cover fillers mixed from multiple materials"); *id.* ("a mixed-material filler is outside the patent's scope"). Because there is no contention that polypropylene itself contains more than one "fraction," as the filler/fractions limitation requires, the district court's construction means that polypropylene can play no role in meeting the limitation—which, instead, must be met solely by either the aluminum trihydrate or the calcium carbonate.

We disagree with the district court's construction. We see no basis in the language or specification for limiting "a

filler" to "one material." We have been pointed to nothing about a customary usage of the term itself, and nothing in the specification's use of it, that excludes from being "a filler" a mixture of two different "materials" (whether that word means a mixture of different molecules or something else). The district court did not rely on the claim term or the specification to draw its conclusion. Instead, the court based its one-material construction entirely on its conclusion that, during prosecution of the '044 patent, "the examiner rejected the claims and requested amendments, citing the Nakano patent and other prior art indicating that polymer-based coatings with two fillers have already been patented." *District Court Opinion* at 2. But we think that the prosecution history does not support the court's adoption of its otherwise-unwarranted narrowing of the term's meaning.

During prosecution, the examiner rejected claims 55-57 of the application as obvious in light of five pieces of prior art, including U.S. Patent No. 5,221,575 (Nakano), which the examiner found "divulge[s] metal foil coated with a silica and graphite filled organopolysiloxane." J.A. 467. Based on a review of this prior art, the examiner concluded that "[i]t would have been obvious to one having ordinary skill in the art to apply known insulating and waterproofing coatings to electrical equipment where the kind of coatings are customarily used." J.A. 468. The examiner explained that claim 58, dependent on claim 56, would actually be allowable if it were "rewritten in independent form to include all of the limitations of the base claim and any intervening claims." J.A. 469. Applicants did so, and that claim became claim 1 in the issued '044 patent.

This history does not establish exclusion of dual-material fillers. Applicants never said anything that states or implies such an exclusion. And even the examiner's language regarding Nakano does not clearly focus on the *number* of materials in what constitutes a filler.

Indeed, what distinguishes the claims rejected based on Nakano and other prior art (claims 55-57) from the claim approved if rewritten in independent form (claim 58) is not, on its face, whether the filler contains one or more "materials," which is not a term in the claims. Moreover, Nakano itself appears to disclose a product containing graphite powder alone as a (single-material) filler. '575 patent, col. 2, lines 38-44, and col. 3, lines 38-68. For all of these reasons, there is no clear prosecution-history narrowing of "a filler" to a single material.

Amcorr makes a claim-differentiation argument that the district court rightly did not embrace. Amcorr suggests that claim 2's requirement that the composition of claim 1 "additionally comprises at least one filler" requires that claim 1's requirement of "a filler" be limited to a single material. But there is no persuasive connection between the claim 1/claim 2 difference and the number of materials that can be in a filler. Indeed, the relation between claim 1 and claim 2 is obscure on its face, and the reason is evident: It results from a sloppy amendment process that conveys nothing about intended scope.

Issued claim 2 was original claim 56, which depended on original claim 55, and original claim 58 (which became issued claim 1) depended on claim 56. In that original arrangement, the greater specificity of claim 58 than of claim 56 made sense. When the examiner said that claim 58 would be approved if rewritten in independent form, applicants did so by amending claim 55, so that the unchanged claim 56 now depended on the substantive claim that previously had depended on it. And the claims issued in this peculiar form as claims 1 and 2. We have often counseled care in drawing inferences from claim differentiation. *See*, *e.g.*, *Marine Polymer Techs., Inc. v. HemCon Inc.*, 672 F.3d 1350, 1359 (Fed. Cir. 2012) (en banc). In the present circumstances, no inference about the scope of claim 1 can fairly be drawn from claim 2.

2

The district court's second ground for holding that polypropylene in the accused products plays no role in meeting the filler/fractions limitation is the conclusion that "[t]he polypropylene in Amcorr's products is not a filler" at all. *District Court Opinion* at 3; *id.* ("[p]olypropylene [in the accused products] is not a filler"). The court's sole explanation is the statement that, in the accused products, "[p]olypropylene mixes with polybutene to form a homogenous polymer mixture." *Id.*

That reasoning, however, does not state a claim construction of "a filler," let alone justify a particular construction by addressing the parties' respective contentions about the term's meaning through the usual analysis. Indeed, the claim-construction portion of the district court's opinion (*id.* at 2) includes nothing about "a filler" except that it must consist of only one material. The opinion thus does not explain the connection between its finding about a "homogenous polymer mixture" and any construction of "a filler."

Nooren has argued that "a filler" should be construed to mean "one or more organic or inorganic components other than the specific, 'apolar, non-thermosetting fluid polymer' that assist in controlling rheological characteristics of the preparation." Brief for Plaintiffs-Appellants at 44; *id.* at 46 ("everything else in the composition, other than the apolar, non-thermosetting fluid polymer, that assists in controlling rheological characteristics of the composition"). But it has barely developed that argument, instead focusing almost entirely on (successfully) challenging the one-material construction of the district court. Nooren's only cited support for this construction is the specification statement that "[t]he rheological characteristics of the preparation . . . can be controlled by means of the amount of filler." '044 patent, col. 3, lines 64-65. That statement, however, does not mean that everything

with a fluid-flow controlling effect is "a filler." And the specification says that, in addition to the fillers, the product "can also contain" petroleum gel and wax (and similar substances)—which, it is undisputed, can affect the fluid-flow character of the overall preparation. '044 patent, col. 4, lines 21-25; J.A. 993.

Amcorr has offered evidence of the ordinary meaning of the term "a filler" that appears to be uncontroverted by Nooren and that appears to fit this patent. The *Condensed Chemical Dictionary* 383 (9th ed. 1977) defines "filler" (in the relevant definition) as "[a]n inert mineral powder of rather high specific gravity (2.00-4.50) used in plastic products and rubber mixtures to provide a certain degree of stiffness and hardness, and to decrease cost." J.A. 501. (It gives calcium carbonate as an example. *Id.*) It adds that "[f]illers have neither reinforcing nor coloring properties, and the term should not be applied to materials that do, i.e., reinforcing agents or pigments." *Id.* On the present state of the record, "a filler" should be accorded that meaning.

But we are not prepared to affirm the district court's conclusion that, as a matter of law, the polypropylene in the accused products is not serving as a filler. The court did not recite the above construction or explain how its observation about the "homogenous polymer mixture"—and the evidence about glass transition temperatures on which it was based, *e.g.*, J.A. 617-18—connects to the claim term's scope, especially in light of the specification's express contemplation that polypropylene can, at least sometimes, serve as a filler. *See* '044 patent, col. 3, line 58. Moreover, the experts disagreed about whether polypropylene in the accused products is serving as a filler. *Compare* J.A. 617-18 *with* J.A. 902-03. The district court, not having articulated a construction, did not parse the experts' evidence for genuine disputes under the proper construction, and we will not do so ourselves. Indeed, the experts' declarations are not focused on how the polypro-

pylene fits, does not fit, or might fit the claim requirement of "a filler" as properly construed—the district court not having provided the experts a construction. In these circumstances, we vacate the district court's summary-judgment ruling that "[t]he prolypropylene in Amcorr's products is not a filler." *District Court Opinion* at 3.

B

For the foregoing reasons, it remains an open question whether polypropylene can be a filler, and thus may be considered as part of any analysis of whether the accused products meet the filler/fractions claim limitation. It is therefore at present unnecessary to decide whether either the aluminum trihydrate or the calcium carbonate in the accused products can by itself meet that limitation. And we choose not to do so.

If we agreed with the district court that each of those two conceded "fillers" itself has *only* one "fraction" meeting the limitation's requirements, as a matter of law, we still could not affirm the judgment of non-infringement, because we leave open whether polypropylene might supply a second such "fraction." If we disagreed with the district court, the ordinary course would be for us to reverse the grant of summary judgment of non-infringement and remand. It is true that we would have the "authority" to consider the (implicit) denial of Nooren's motion for summary judgment of infringement, *i.e.*, to decide if, as a matter of law, either the aluminum trihydrate or the calcium carbonate itself has at least two fractions with the required properties. *See*, *e.g.*, *Dey L.P. v. Sunovion Pharm. Inc.*, 715 F.3d 1351, 1360 n.5 (Fed. Cir. 2013). But we are not required to do so, and here we exercise our discretion not to proceed to the question of infringement as a matter of law. There has been insufficient exploration in the record, both here and in the district court, of too many questions of apparent relevance to identifying a proper construction of the limitation,

which requires, among other things, that the construction itself supply "a meaningfully precise claim scope." *Halliburton Energy Servs., Inc. v. M–I LLC,* 514 F.3d 1244, 1251 (Fed. Cir. 2008); *see MeadWestVaco Corp. v. Rexam Beauty and Closures, Inc.*, 731 F.3d 1258, 1270 n.8 (Fed. Cir. 2013).

Regarding claim construction, the district court said the following:

> 3. *Single Material, Multiple Fractions*
>
> . . .
>
> The filler must include multiple fractions, each with a distinct particle size distribution. For the filler limitation to be meaningful, each fraction must have both a discrete range of particle sizes as well as a high number of particles in that range. Without this threshold, any variation in size would be a different fraction, and infringement would be unavoidable.
>
> On a size-distribution graph, a different fraction would be represented by a distinct peak. A minor bump does not distinguish a separate fraction. A graph representing multiple fractions would require at least a bimodal distribution with two or more predominate peaks.

District Court Opinion at 2. Applying this construction, the court then added the following:

> 4. *Amcorr's Fillers.*
>
> Amcorr's filler materials—calcium carbonate and aluminum trihydrate—have unimodal particle distributions and are not covered by Nooren's patent. The distribution graph for each filler has a single peak. The minor protrusions and changes in slope are not peaks. They show multiple particle sizes but not multiple fractions.

Id. This reasoning leaves us with a host of questions, which we think would be better addressed initially by more focused analysis—and, if necessary, more focused record development—on remand.

The claim limitation at issue requires a filler that includes "a plurality of fractions each comprising different size particles, and wherein said different fractions have different particle size distributions." '044 patent, col. 8, lines 16-18. It is the usual (though not invariable) rule that, in patent claims as elsewhere, the construction of a clause as a whole requires construction of the parts, with meaning to be given to each part so as to avoid rendering any part superfluous. *See 3M Innovative Props. Co. v. Tredegar Corp.*, 725 F.3d 1315, 1329 (Fed. Cir. 2013); *see also Duncan v. Walker*, 533 U.S. 167, 174 (2001); *Medlin Constr. Grp., Ltd. v. Harvey*, 449 F.3d 1195, 1200-01 (Fed. Cir. 2006). Terms generally carry their ordinary and customary meaning in the relevant field at the relevant time, as shown by reliable sources such as dictionaries, but they always must be understood in the context of the whole document—in particular, the specification (along with the prosecution history, if pertinent). *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-18 (Fed. Cir. 2005) (en banc); *see also Sandifer v. United States Steel Corp.*, 134 S. Ct. 870, 876-77 (2014) (statute construed by discerning ordinary meaning at relevant time, relying on dictionaries).

The district court did not separately construe "fraction," "different size particles," and "different particle size distributions." It is not clear that the court gave "different size particles" a meaning that avoids redundancy with "different particle size distributions." And it is not clear whether, in saying that "each fraction must have both a discrete range of particle sizes as well as a high number of particles in that range," the court was construing "fraction" or instead was stating a conclusion about some combination of "fraction" with one or the other of the two

properties the limitation requires for the fractions: each fraction must have "different particle sizes," and different fractions must have "different particle size distributions."

Nooren proposes in this court that "fractions" means any "part of a whole." Brief for Plaintiffs-Appellants at 26. But it does not cite any reliable source for that usage being the ordinary meaning in the relevant field. And because Nooren's proposal ("part," with no further clarification whatever) seems to cover *any* proper subset of any collection of particles, without regard to size ranges or any other characteristic, it is not clear that this proposed meaning would, once the other terms were properly construed, leave the limitation as a whole with a sensible and definite meaning.[1] The district court's reference to the need for "the filler limitation to be meaningful" may reflect this concern. *District Court Opinion* at 2. Amcorr, for its part, relied on two portions of the definition of "fraction" in the *McGraw-Hill Dictionary of Scientific and Technical Terms* 799 (5th ed. 1994): "[MET] In powder metallurgy, that portion of sample that lies between two stated particle sizes. Also known as cut. [SCI TECH] A portion of a mixture which represents a discrete unit and can be isolated from the whole system." J.A. 505. The district court's "discrete range" language, if it means to define "fractions" (rather than one of the other terms of

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[1] In Nooren's apparent proper-subset sense, a collection of 1,000,000 particles would have $2^{1,000,000} - 2$ distinct "parts." The limitation at issue would require only that there be two "parts" (*e.g.*, one subset consisting of a 1 μm particle and a 3 μm particle, another consisting of a 2 μm, 5 μm, and 10 μm particle) that would be tested for meeting the size and size-distribution requirements. Depending on what those two requirements mean, the requirements might be met for practically any real-world collection of particles.

the limitation), may be based on combining selected portions of this definition.

The claim language requires that each fraction (however defined) have two features. It must have "different particle sizes"—which suggests simply that the particles in that fraction must not all be of the same size. And its "particle size *distribution*" must differ from that of the other fractions that make up the required plurality. Given the terms used and the presumptive need to avoid redundancy with the first requirement, that requirement suggests that the *mix* of different-size particles within a fraction must show a pattern that differs from the pattern shown by the mix of different-size particles within the other fractions making up the claimed plurality. For example, perhaps one pattern would be accurately represented by a bell curve, another by an asymmetrical curve, in an apples-to-apples comparison after choosing one from among the several options for graphing distributions (discussed *infra*).

But it is by no means clear that these understandings are ultimately the right ones. In particular, the specification, in contrast to the claim's requirement that an individual fraction have "different particle sizes" (a plural phrase), speaks of "each fraction having a different particle size" (a singular phrase) "and a different particle size distribution." '044 patent, col. 4, lines 1-2. The singular phrase used for "different particle size" suggests, contrary to the claim language, a comparison of the particle sizes between fractions rather than within a fraction—so that there is no overlap in size (*e.g.*, diameter) between particles in one fraction and particles in another. A proper claim-construction analysis would have to consider whether this disparity affects the proper construction, which depends on, among other things, the clarity of the claim language and whether a specification statement rises to the level of redefinition or disclaimer.

The district court, like the parties, turned to various graphical representations of collections of particles in discussing (and then applying) its claim construction. *District Court Opinion* at 2. There are at least two problems with this discussion. First, there are a number of different possible graphs involving particle size used in the field: one cannot speak of "*[t]he* distribution graph." *Id.* (emphasis added). For example, a text submitted to the district court explained that there are varying techniques for measuring the size of particles (*e.g.*, sieving, sedimentation, light scattering); the x-axis, showing particle size, can be linear or logarithmic; the y-axis can show the number (frequency) or volume or mass of particles of any given size, often normalized by using percentages; and the resulting graphs can be quite different. *See* H. MERKUS, PARTICLE SIZE MEASUREMENTS: FUNDAMENTALS, PRACTICE, QUALITY 13, 15, 18, 20, 23 (2009), *available at Frans Nooren Afdichtingssytemen*, No. H-10-3150, ECF 24-3. The parties here relied on graphs of varying methods—using particle numbers (J.A. 934), mass (J.A. 411, 412), and volume (J.A. 413, 903). The differences cannot be ignored: it seems that "peaks" appearing on one graph can disappear on another, for the very same particle collection.[2] If the claim scope turned

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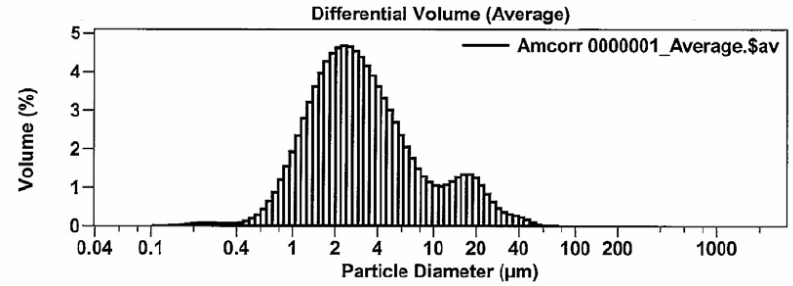
[2] Solely for illustrative purposes, consider the graph at J.A. 935, which Nooren relies on as showing (at least) two peaks even under the district court's construction:



on numbers of peaks, it may matter considerably which graph is used. Moreover, where results can dramatically differ according to which of several quantitative techniques for applying a claim term is chosen, and the patent does not make clear which technique is meant, an indefiniteness problem may arise. *See Honeywell Int'l, Inc. v. ITC*, 341 F.3d 1332, 1338-40 (Fed. Cir. 2003).

The graph, using a logarithmic scale for particle size, shows the percent of overall *volume* made up by particles of a given size. Nooren has identified as a second "peak" the local maximum on the right as the curve goes from particles of about 12 μm diameter to particles of about 18 μm diameter. The heights at those points appear to be about 1.1 and 1.3 (on the y-axis scale, measuring percent of total volume). The curve at 18 μm is *higher* than at 12 μm—about 18% higher (1.3/1.1 is about 1.18).

A frequency curve for the same particle collection (showing the number of particles, in absolute or percentage terms) would seem to erase the volume-curve peak at 18 μm. If the volume is proportional to the cube of the particle radius, as is true for a sphere, then a graph showing the frequency of particles by *number* would be *lower* at 18 μm than at 12 μm: the height at 18 μm diameter (9 μm radius) would be only about one-third the height at 12 μm diameter (6 μm radius). (Assuming away packing, the ratio of the volumes of the particles at those two diameters is 729/216 [$9^3/6^3$] times the ratio of the numbers of such particles; *i.e.*, the ratio of the numbers of particles at those two diameters is 216/729 times the ratio of the volumes of particles at those two diameters. A volume ratio of 1.18, times 216/729, is a number-of-particles ratio of about .35, *i.e.*, roughly one-third.) On these assumptions, simply changing from a volume graph to a frequency graph replaces a curve that is higher at 18 μm than at 12 μm with one that is lower at 18 μm than at 12 μm.

Second, the district court, in describing what it thought a graph must show to satisfy the limitation requiring at least two fractions with certain properties, spoke of "a high number of particles" in a "discrete range," a "distinct peak," and a "bimodal distribution with two or more predominate peaks," contrasting a "minor bump," "minor protrusions," and "changes in slope." *District Court Opinion* at 2. At least some of these terms raise evident questions of precision as to their boundaries. (Although "changes in slope" has a precise mathematical meaning, covering any curve without a constant slope, Nooren, in using the term, evidently means something else, since it seems to view a smooth bell curve as lacking such changes, even though its slope is always changing.) Again, such terms can raise an indefiniteness problem. *See Halliburton Energy,* 514 F.3d at 1251.

In enumerating problems relevant to arriving at a proper construction, we do not mean to be exhaustive or to suggest the absence of solutions. Nor do we address the consequences for infringement or invalidity, including what questions have to be answered (given the potential availability of polypropylene as part of a filler) in order to arrive at a final judgment. Rather, we are identifying at least some of the problems that require attention in a more focused and systematic claim-construction analysis than the parties and the record currently supply.

CONCLUSION

For the foregoing reasons, the judgment of the district court is vacated, and the case is remanded for further proceedings consistent with this opinion.

No costs.

VACATED AND REMANDED