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UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT TRIAL AND APPEAL BOARD

Ex parte FINA TECHNOLOGY, INC.
(Application 12/506,317)

Appeal 2011-011853
from Technology Center 1700

Before CHARLES F. WARREN, RICHARD TORCZON, and CHRISTOPHER L. CRUMBLEY, *Administrative Patent Judges*.

TORCZON, *Administrative Patent Judge*.

DECISION ON APPEAL

The appellant (Fina) seeks relief from the final rejection of claims 1, 2, 4-11 and 13-24. We affirm-in-part.

OPINION

BACKGROUND

Fina discloses methods of dehydrogenating hydrocarbons to form alkenes, such as isoprene, piperylene and butadiene.[1] Claim 1, one of three independent claims, defines the invention as:[2]

> A method for the production of alkenes comprising:

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[1] Spec. ¶0002.
[2] Br. 14 (Claims Appendix), on which we rely for all claim language. Ans. 3.

contacting a hydrocarbon feedstock with a dehydrogenation catalyst in a reactor, at a pressure of 1,000 mbar or less, under reaction conditions effective to dehydrogenate at least a portion of said hydrocarbon to produce alkenes;

wherein the hydrocarbon to alkene conversion is at least 30%;

wherein the reactor temperature increase from catalyst deactivation averages no more than 1°C per day for at least 30 days; and

wherein the reaction can operate in excess of 30 days before the catalyst is a deactivated catalyst.

REJECTIONS

Claim 1 and Kowaleski

The examiner rejected claims 1, 2, 5-11, 13-14 and 17 as having been obvious[3] from the disclosures in a United States published patent application (Kowaleski).[4] Fina notes that independent claims 1 and 17 include the limitation "wherein the reactor temperature increase from catalyst deactivation averages no more than 1°C per day for at least 30 days".[5] Fina urges that this limitation requires "a process that continues for at least 30 days at a hydrocarbon to alkene conversion of at least 30%."[6] Fina further contends that the Examiner has not addressed this requirement.[7]

Kowaleski discloses processes of dehydrogenating hydrocarbons using an iron oxide-based catalyst.[8] Preferred feedstocks include isoamylenes

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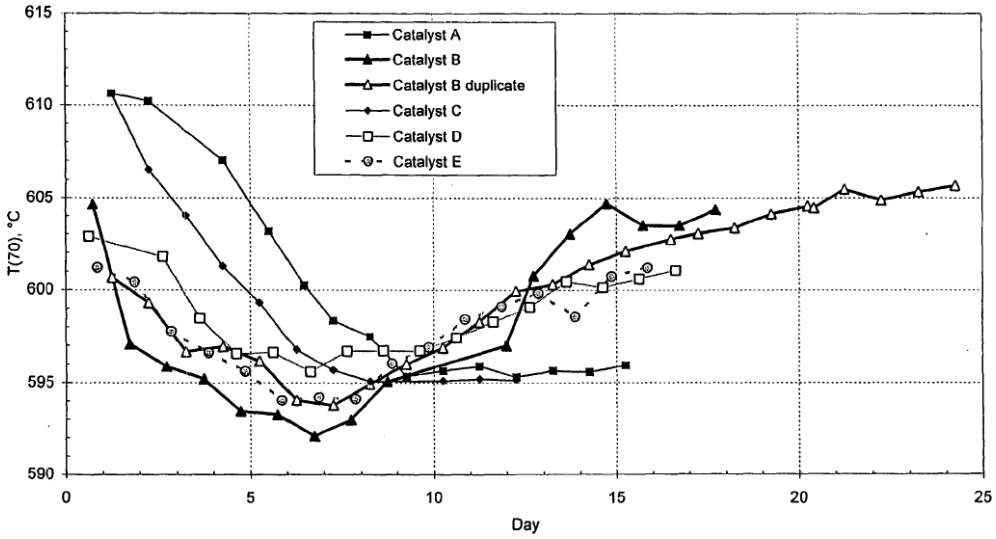
[3] Final Rej. 4, citing 35 U.S.C. 103.
[4] R.M. Kowaleski, *Process for the manufacture of an alkenyl aromatic compound under low steam-to-oil process conditions*, US 2006/0106267 A1.
[5] Br. 9.
[6] *Id*. 10.
[7] *Id*.
[8] Kowaleski, abstract.

(dehydrogenated to isoprenes) and butenes (dehydrogenated to butadiene).[9] The examiner noted that isoprene and butadiene are alkenes.[10] Dehydrogenation may occur in a dehydrogenation reactor at relatively low pressure, from 0 kPa (typically 20 kPa) to about 200 kPa.[11] The examiner noted that this range converts to 0-2000 mbar, which substantially overlaps the claimed range of 1000 mbar or less.[12]

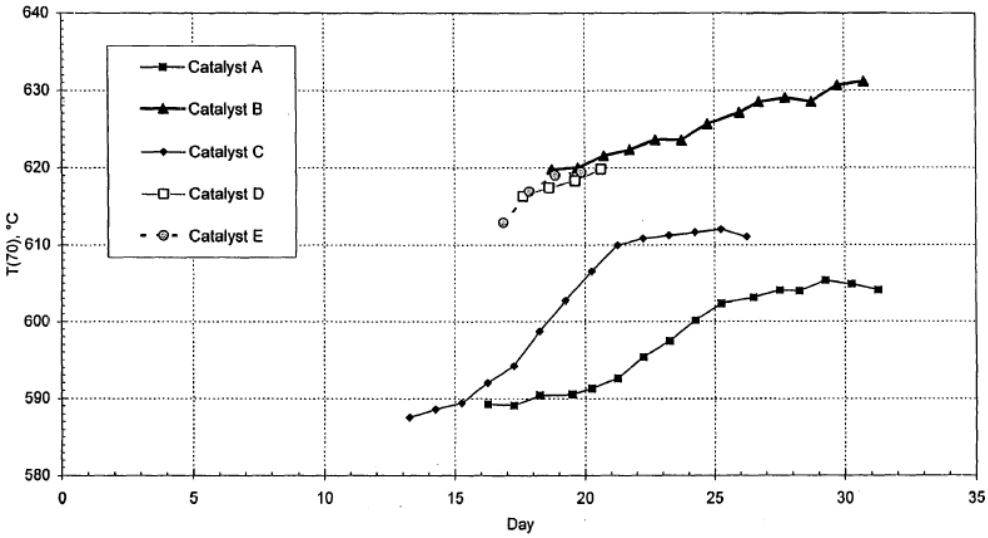
Kowaleski reports an example in which three catalysts were tested at 76 kPa with a 10:1 steam-to-feedstock molar ratio. The catalysts were activated and broken in at 600°C for 7-10 days, then the temperature was adjusted daily such that each test run achieved a 70% mole conversion of the feedstock.[13] The examiner noted that 70% conversion is within the claimed conversion rate of at least 30%.[14]

Kowaleski was concerned with the effect of titanium concentration and provides Figure 1 (right), which shows lower initial activity for catalysts A and C (low titanium), but that after about 10 days they stabilized and exceeded the activity of the other catalysts.[15]



[9] *Id*. ¶0053.
[10] Final Rej. 4.
[11] Kowaleski ¶¶0054-55.
[12] Final Rej. 4.
[13] Kowaleski ¶¶0014 & 0068.
[14] Final Rej. 5.
[15] Kowaleski ¶0069.

After the time shown in Figure 1, pressure was reduced to 40 kPa and the relative amount of steam to feedstock (5:1) was increased. After four days at the new conditions, the temperature was adjusted such that each test run achieved a 70% mole conversion of the feedstock.[16] Figure 2 (below) shows the activity of catalysts A and C improving toward the end of their runs, while the performance of the other catalysts continued to decline. The examiner found that Kowaleski discloses a run for catalyst A of over thirty days, including sixteen days of operation at 70% conversion (Figure 1) and then fifteen days at 70% conversion (Figure 2), for a total of 31 days at 70% conversion, which the examiner noted would provide at least 30 days of operation with at least 30% conversion.[17] The examiner also found that the operating temperature for catalyst A is actually lower at the end of the reported data, such that the temperature increase attributable to catalyst inactivation must average no more than 1°C per day.[18]



Fina's contention that the examiner did not address the limitation that "a process that continues for at least 30 days at a hydrocarbon to alkene conversion of at least 30%"[19] is problematic. First, claim 1 does not contain such a limitation. The claim does not specify a time period for the alkene conversion rate limitation,

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[16] *Id*. ¶¶0015 & 0070.
[17] Final Rej. 5.
[18] *Id*.
[19] Br. 10.

while the limitations requiring thirty days do not refer to an alkene conversion rate. Indeed, the second reference in the claim to thirty days does not even require a thirty day period, but only that the reaction "can operate" in excess of thirty days before the catalyst is deactivated. Moreover, the claim does not require that the period be continuous.

Assuming arguendo the correctness of Fina's claim paraphrase, the examiner did address the requirement inasmuch as the examiner addressed all of the constituent limitations of the paraphrase. The examiner pointed to an example in Kowaleski where the run for one catalyst exceeded thirty days, included a conversion rate over 30% and an average reactor temperature increase of less than 1°C per day over thirty days. Although Fina does not expressly make the point, the examiner's position has some weaknesses. In particular, the run includes two stabilization periods that amount to one-third to one-half of Kowaleski's run time. Moreover, if the average reactor temperature is calculated from the end of the catalyst break-in period for catalyst A rather than from the start of the run, there is a gentle increase rather than a decrease in temperature.[20] Nevertheless, at the end of the run, the temperature-performance of the catalyst is shown to be stable or even improving. This stability or improvement would have suggested to a person having ordinary skill in the art that Kowaleski's catalyst A would be likely continue to work at least within the parameters of what Fina is now claiming.

While our reading of Kowaleski is less directly supportive of the rejection than the examiner's reading, we nevertheless conclude that a preponderance of the evidence of record still supports the rejection of claim 1. Fina has provided no

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[20] About 598°C (day 7) or 596°C (day 10), in Figure 1, to about 604°C at the end of the run in Figure 2. If only the run in Figure 2 is considered, the average temperature increase over the run for catalyst A appears to be exactly 1°C per day, with the temperature starting to decrease again.

other grounds of relief for claims 2, 5, 6, 13, 14 and 17, so they share the fate of claim 1. Similarly, although claims 4, 15, 16, 18 and 19 are rejected over the combined disclosures of Kowaleski and a patent (Milam),[21] Fina has not provided additional grounds for relief, so these claims also share the fate of claim 1.

Claim 20, Kowaleski and Lide

The examiner rejected claim 20 as having been obvious[22] from the disclosures in Kowaleski as understood in light of data from a reference work (Lide).[23] As an initial matter, we do not understand the examiner to be using Lide as a prior art teaching so much as a source for a technical definition.[24] Evidence extrinsic to a reference may be used to explain how a person having ordinary skill in the art would have understood the reference.[25] Consequently, we understand the rejection to rely on Kowaleski alone as prior art, as was the case for the rejection of claim 1. In any case, Fina has not challenged the role of Lide in this rejection despite its late publication date.

Fina instead relies on the same arguments it advanced for claim 1. Consequently, claim 20 shares the fate of claim 1. Claims 21-24, which depend from claim 20, were rejected as having been obvious from the combined

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[21] Final Rej. 8-10, *additionally citing* S.N. Milam and B.H. Shanks, *Dehydrogenation catalyst and process*, U.S. Pat. 5,962,757 (1999).
[22] Final Rej. 10.
[23] CRC HANDBOOK OF CHEMISTRY AND PHYSICS, unspecified page (D. R. Lide ed., 91st ed. 2011 Internet ed.).
[24] Compare Final Rej. 10 ("Kowaleski, as evidenced by Lide") and Final Rej. 8 ("Kowaleski…further in view of Milam"); Final Rej. 11 ("In the case of a 1-butene feed, the boiling point of the 1,3-butadiene product is even lower than that of styrene (data from Lide).").
[25] *E.g.*, *In re Baxter Travenol Labs*., 952 F.2d 388, 390 (Fed. Cir. 1991) (explaining that extrinsic evidence may be considered when it is used to explain the meaning of a reference).

disclosures of Kowaleski and Milam.[26] Fina has not provided any additional ground for relief, so these claims share the fate of claim 20.

Claims 7-11

The examiner rejected claims 7-11 as having been obvious from Kowaleski's disclosures.[27] These claims depend via claim 2 from claim 1. Each of claims 7-11 include a further limitation of "operating the dehydrogenation reaction at a steam to hydrocarbon molar ratio of at least [N]:1", where N is 12 for claims 7, 8 and 10, 14 for claim 9 and 15 for claim 11. In each case, the ratio is greater than the ratios of 10:1 and 5:1 in the example on which the examiner relied.

Kowaleski teaches that steam plays several important roles in dehydrogenation processes, including extending the life of typical dehydrogenation catalysts.[28] Although low steam-to-feedstock process conditions can be desirable, they are typically limited by the properties of the dehydrogenation catalyst. Kowaleski teaches that typically processes use ratios exceeding 9:1, up to 20:1.[29] From this teaching, the examiner inferred that those in the art would have known to use higher ratios for the advantages obtained from using steam generally.[30]

Kowaleski teaches that the ratios for the catalysts of its invention are lower than usual, preferably less than 9:1 and more preferably even less than 5:1.[31] Fina argues that this teaching is, in fact, a teaching away from using a higher ratio.[32] The threshold for a teaching away is much higher than a preference for an

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[26] Final Rej. 12.
[27] *Id*. 4.
[28] Kowaleski ¶0003.
[29] *Id*. ¶0019; *cf*. Milam 3:62-65 (teaching ratios of 2:1 to 20:1 and preferably 5:1 to 13:1 for its catalysts).
[30] Final Rej. 6.
[31] Kowaleski ¶0023.
[32] Br. 10-11.

alternative.[33] In the present case, Kowaleski's teaching falls well short of a teaching away. For example, while it teaches a preferred ratio of less than 9:1, the example on which the examiner relies starts with a ratio of 10:1. We cannot find that Kowaleski intended a firm upper limit of no more than 9:1.

Although Kowaleski does not teach away, this finding begs the question whether it positively teaches or suggests a modification to higher ratios. The examiner relies on an example with several precise parameters in order to find a basis for rejecting the limitations of claim 1, which limitations carry over to dependent claims 7-11. Indeed, one parameter is the steam-to-feedstock ratio, which starts at 10:1 and is reduced to 5:1. Kowaleski does not provide a suggestion that increasing the ratio would produce comparable results; if anything, it suggests the opposite. We do not find that Kowaleski teaches away from using ratios greater than 10:1 or that such ratios could not work with Kowaleski's catalysts. We simply find a lack of evidence in this record supporting a reasonable expectation that higher ratios would work with a catalyst in a way that also meets the other claim limitations.

HOLDING

Final rejection of claims 1, 2, 4-6 and 13-24 is affirmed, but final rejection of claims 7-11 is reversed.

AFFIRMED-IN-PART

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For the appellant: BRADLEY A. MISLEY, Misley P.C., of Cypress, Texas.

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[33] *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004).