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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* PETER KAPITAN and ALEXANDER SAJTOS

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Appeal 2021-001272  
Application 14/409,522  
Technology Center 1600

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Before DONALD E. ADAMS, TAWEN CHANG, and  
RACHEL H. TOWNSEND, *Administrative Patent Judges*.

TOWNSEND, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant<sup>1</sup> appeals from the Examiner's decision to reject claims to a process for the manufacture of methylfluoroacrylate as being obvious. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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<sup>1</sup> We use the word Appellant to refer to “applicant” as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Patheon Austria GmbH & CO KG, which is a wholly-owned, indirect subsidiary of Thermo Fisher Scientific Inc. (Appeal Br. 1.)

STATEMENT OF THE CASE

Appellant's Specification explains that condensation reactions of formic or oxalic acid with alkyl monofluoroacetates in the presence of a strong acid followed by reaction with paraformaldehyde are known in the prior art. (Spec. 1.) In particular, the Specification states:

Crossed Claisen condensation of alkyl monofluoroacetates with esters of formic acid or oxalic acid in the presence of strong bases, followed by a reaction with paraformaldehyde represents one of the most widely used methods for the synthesis of  $\alpha$ -fluoroacrylates. This method was first disclosed in 1966 in patents US3262967 and US3262968, both improvements of the method of US3075002. The reaction is usually carried out using alkali metal hydrides or alkoxides in high boiling solvents such as tetrahydrofuran (THF), diethylether (Et<sub>2</sub>O), methyl-tert-butylether (MTBE), dimethylsulfoxide (DMSO) or toluene[.]

(*Id.*) The Specification goes on to explain that the condensation reaction is “an equilibrium reaction” and that the reaction, afterward, with paraformaldehyde results in the product containing up to 5% methyl fluoroacetate, “which cannot be completely removed by distillation.” (*Id.*) It is further explained that “[p]urification of MFA from starting material, residual solvents and side-products is difficult because of very close boiling points[,] and careful column vacuum distillation is required.” (*Id.*)

Appellant's invention is directed at “an improved process . . . with high purity in high yield and easy isolation.” (Spec. 1.)

Claims 1, 2, 4, and 7–13 are on appeal. Claim 1, reproduced below, is illustrative of the claimed subject matter:

1. A process for the manufacture of a methylfluoroacrylate, comprising the following steps:

A. a methylfluoroacetate with an ester of oxalic acid is reacted in the presence of a base and a suitable solvent in a crossed Claisen condensation reaction resulting in a Claisen salt;

B. the Claisen salt obtained in step A is optionally filtered off and washed with a suitable solvent;

C. the Claisen salt obtained in step A or B is reacted with paraformaldehyde in a suitable solvent;

D. the methylfluoroacrylate obtained in step C is isolated using a suitable solvent,

wherein the methylfluoroacrylate isolated after distillation has a purity of at least 99.5 wt%, contains below 0.5 wt% methylfluoroacetate and below 2.0 wt% dimethyl carbonate;

wherein the solvent in at least steps C and D and optionally in one of steps A or B is an alkane selected from a group consisting of pentane and hexane.

(Appeal Br. 21 (Appendix of Claims).)

The prior art relied upon by the Examiner is:

Name	Reference	Date
Sedlak (Sedlak '002)	US 3,075,002	Jan. 22, 1963
Sedlak et al. (Sedlak '967)	US 3,262,967	July 26, 1966
Ito et al.	US 6,509,134 B2	Jan. 21, 2003
Zhenjiang Radiant Pharmaceutical Technology Co., LTD (Zhenjiang)	CN 102211998 <sup>2</sup>	Oct. 12, 2011

The following grounds of rejection by the Examiner are before us on review:

Claims 1, 2, 4, 7, 8, and 11–13 under 35 U.S.C. § 103(a) as unpatentable over Zhenjiang, Sedlak '967, and Ito.

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<sup>2</sup> The Examiner relies on an English translation of this reference as do we.

Claims 9 and 10 under 35 U.S.C. § 103(a) as unpatentable over Zhenjiang, Sedlak '967, Ito, and Sedlak '002.

#### DISCUSSION

The Examiner found that Zhenjiang discloses a method for synthesizing methyl fluoroacrylate as substantially set forth in claim 1 except that it does not disclose using pentane or hexane as the solvent in the reaction steps, or the at least 99.5% purity limitation. (Final Action 4, 5.) The Examiner determined that it would have been obvious to have used pentane or hexane as the solvent instead of the solvents disclosed in Zhenjiang in light of the teachings of Sedlak '967. (*Id.* at 5.) In particular, the Examiner found that Sedlak '967, like Zhenjiang, discloses a method of making methyl fluoroacrylate. (*Id.*) The Examiner noted that the Sedlak '967 method uses inert solvents, and includes in the group of such solvents to choose from, petroleum ether. (*Id.* at 4 (citing Sedlak '967 col. 2, l. 13).) The Examiner finds that

the petroleum ether used in the Sedlack [sic] '967 patent appears to be functional equivalent to the pentane and hexane that is used in the instantly claimed process since both the process disclosed in the Sedlack [sic] '967 patent and the process recited in the instant claims are drawn to preparation of alkylfluoroacrylates.

(*Id.* at 6.)

The Examiner further found that “petroleum ether consists of pentane and hexane hydrocarbons.” (Final Action 4.) The Examiner additionally found that Sedlak '967 teaches that, “at the end of the reaction . . . the process disclosed in the Sedlak et al patent involve[s] the reaction being neutralized and worked up, which is performed in an inert organic solvent

that may be selected as pentane, to extract the neutralized product, which embraces the latter part of step C or the initial part of step D of instant Claim 1.” (*Id.* at 5.)

The Examiner also found that Zhenjiang and Sedlak ’967 disclose the option to use[] identical inert solvents. See paragraph 0020 of the Zhenjiang publication wherein the solvent may be selected as diethyl ether and tetrahydrofuran along with the methyl tert-butyl ether and see lines 12 and 13 of column 2 in the Sedlak et al patent wherein tetrahydrofuran and ether may be selected as the solvent along with petroleum ether.  
(Final Action 5.)

Regarding the recited purity limitation, the Examiner found that Ito also discloses a process for manufacturing alkyl fluoroacrylates (Final Action 5), and that an Example in which methyl  $\alpha$ -(trifluoromethyl) acrylate, i.e., a methylfluoroacrylate, was “purified by fractional distillation to obtain fractions purer than 99.5%.” (*Id.* (citing Ito Example 3, and col. 19:12).)

The Examiner concluded from the foregoing teachings of the references that

it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the solvent used to react paraformaldehyde with the intermediate reaction product for synthesizing methyl-fluoroacrylate [sic] in the Zhenjiang publication with pentane or hexane in view of the recognition in the art, as suggested in the Sedlak et al patent, that petroleum ether consisting of pentane or hexane as a solvent would be effective in providing fluoroacrylates in good yield and purity, as further suggested in the Ito et al patent which discloses a fluoroacrylate fractions having a purity of at least 99.5%.

(Final Action 6.)

We do not agree with the Examiner's conclusion of obviousness. Claim 1 requires, through a wherein clause, that "the solvent in at least steps C and D . . . is an alkane selected from a group consisting of pentane and hexane." The claimed process is one "comprising" steps A–D, and that comprising language "indicates that the claim is open-ended and allows for additional steps." *Invitrogen Corp. v. Biocrest Mfg., L.P.*, 327 F.3d 1364, 1368 (Fed. Cir. 2003). However, that additional steps may be allowed does not mean that the solvent for use in the reaction step C as modified by the wherein clause, i.e., the alkane solvent to be used in the reaction of the Claisen salt with paraformaldehyde, being "selected from a group consisting of pentane and hexane," can be something other than pentane or hexane. *See Amgen, Inc. v. Amneal Pharms. LLC*, 945 F.3d 1368, 1377–78 (Fed. Cir. 2020) (discussing in detail *Multilayer Stretch Cling Film Holdings, Inc. v. Berry Plastics Corp.*, 831 F.3d 1350 (Fed. Cir. 2016)). In *Multilayer*, the "issue was whether element (b) by itself declared that each layer among the five inner ones was restricted to the listed resins" by the use of the closed Markush transition phrase "selected from the group consisting of." *Amgen*, 945 F.3d at 1377. As the *Amgen* court noted:

The *Multilayer* claim limitation required, in terms, that "each layer" among the identified inner layers be "selected from" the Markush group. The only question was the meaning of the "consisting of" language applicable to "each layer."

(*Id.*) Just as was the case in *Multilayer*, the suitable solvent required to be used in step C (as well as step D) is "selected from" a specific Markush grouping, i.e., pentane and hexane.

The Examiner has not established that the prior art teaches the use of pentane or hexane as the solvent for the reaction of a Claisen salt with

paraformaldehyde as required by claim 1. Sedlak '967 teaches that the reaction product from the reaction of an alkyl formate with an alkyl fluoroacetate in the presence of a strong acid may be reacted with an aldehyde, such as paraformaldehyde, also in the presence of a strong base and an inert solvent. (Sedlak '967 1:40–2:14.) It is true, as the Examiner noted, petroleum ether is in the list of inert solvents that may be present. (*Id.* at 2:11–14.) However, the Examiner has not provided evidence establishing that petroleum ether is only either pentane or hexane. Sedlak '967 does not teach that to be the case.

Moreover, during prosecution, Appellant provided several prior art references noting that petroleum ether is not a single composition, and that, in fact, it is a mixture of aliphatic hydrocarbons. (Appeal Br. 10–11.) One such reference, specifically indicates that not all petroleum ethers contain hexane. *Petroleum Ether Aliphatic Hydrocarbon Mixture CAS No., 78(12) J Chem. Ed., 1588 (2001)* (“Some petroleum ethers, particularly those used as rubber solvents, may contain *n*-hexane.”) This same reference provides a number of examples of compositions that are known as petroleum ethers. (*Id.*) One of those is “naphtha 8002-05-9,” that is described in the US’s National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards as being “[a] *mixture* of paraffins (C<sub>5</sub> to C<sub>13</sub>) that may contain a small amount of aromatic hydrocarbons.” NIOSH Pocket Guide to Chemical Hazards: Petroleum distillates (naphtha), available at <https://www.cdc.gov/niosh/npg/npgd0492.html> (emphasis added). Another example is VM&P naphtha 8032-32-4, which is described in the US’s National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards as being “a refined petroleum solvent predominantly C<sub>7</sub>-



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C<sub>11</sub> which is typically 55% paraffins, 30% monocycloparaffins, 2% dicycloparaffins & 12% alkylbenzenes.” NIOSH Pocket Guide to Chemical Hazards: VM & P Naphtha, available at <https://www.cdc.gov/niosh/npg/npgd0664.html>.

Another such chemical is “rubber solvent 8030-30-6,” that is described in the US’s National Institutes of Health, National Library of Medicine ChemIDplus substance database as consisting of “hydrocarbons having carbon numbers *predominantly* in the range of C5 through C6 and boiling in the range of approximately 38.degree.C to 93.degree.C (100.degree.F to 200.degree.F).” NIH ChemIDplus Substance Name: Petroleum ether RN:8030-30-6 available at <https://chem.nlm.nih.gov/chemidplus/rn/8030-30-6> (emphasis added). And still another is identified as “Stoddard solvent 8052-41-3” that is described in the US’s National Institutes of Health, National Library of Medicine ChemIDplus substance database as a “[m]ixture of straight & branched chain paraffins, naphthenes Assoc (cycloparaffins) & alkyl aromatic hydrocarbons” “that boils in the range of approximately 149.degree.C to 204.5.degree.C (300.degree.F to 400.degree.F).” NIH ChemIDplus Substance Name: Stoddard Solvent RN:8052-41-3 available at <https://chem.nlm.nih.gov/chemidplus/rn/8052-41-3>.

As Appellant explains, and we agree based on the foregoing, “the multiplicity of specifications and synonyms for petroleum ether is caused by numerous variations of petroleum ether components.” (Appeal Br. 11.) Consequently, that Sedlak ’967 teaches using “petroleum ether” in its reaction scheme as an inert solvent does not indicate that it describes using pentane or hexane alone as a suitable inert solvent. Furthermore, the fact

that Sedlak '967 teaches pentane may be used *to extract* product from the neutralized reaction mass also does not establish that pentane would be a suitable *inert solvent* for the reaction of the intermediate formed in the Zhenjiang process with paraformaldehyde.

Furthermore, we do not agree that just because there is some overlap between the list of inert solvents that may be used in the Zhenjiang process and those that may be used in the Sedlak '967 process, such overlap establishes functional equivalence of the use of pentane and hexane recited in Appellant's claim (Ans. 8). First, as already noted, Sedlak '967 does not identify pentane or hexane as being the suitable inert solvent for use in the paraformaldehyde reaction. Second, we note that the intermediate that is reacted with paraformaldehyde in Sedlak '967, a fluoroacetate ester, is different than that in Zhenjiang, an enolate. In other words, the reaction schemes of Zhenjiang and Sedlak '967 are indisputedly different. And, even if Sedlak '967 disclosed the use of only pentane or hexane as the solvent in its reaction scheme, which it does not, the Examiner has not established that its use in a different reaction scheme with different reactants would provide reasonably predictable results.

It is not relied on to establish pentane and hexane are known equivalent inert solvents for use in either the Sedlak '967 chemical process or the Zhenjiang chemical process.

“[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability.” *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). For the reasons discussed above, the Examiner has not established from the prior art cited that pentane or hexane would have been obvious to select as equivalent alternatives of the

inert solvents identified in Zhenjiang for use in the paraformaldehyde reaction step, in the preparation of a methyl-alphafluoroacrylate from fluorine acetate and dimethyl oxalate as starting materials.

Consequently, we reverse the Examiner's rejection of claims 1, 2, 4, 7, 8, and 11–13 under 35 U.S.C. § 103(a) as unpatentable over Zhenjiang, Sedlak '967, and Ito.

Furthermore, Sedlak '002 does not cure the deficiency noted above. In particular, Sedlak '002 teaches “[i]llustrative solvents” that can be used in the reaction of formaldehyde with fluoroacetate in substantially equimolar proportions in the presence of a strong base to yield an alpha-fluoroacrylate “include, for instance: ether, benzene, petroleum ether, ethanol, methanol and the like.” (Sedlak '002 1:33–68.) Thus, we also reverse the Examiner's rejection of claims 9 and 10 under 35 U.S.C. § 103(a) as unpatentable over Zhenjiang, Sedlak '967, Ito, and Sedlak '002.

#### DECISION SUMMARY

In summary:

<b>Claim(s) Rejected</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>	<b>Affirmed</b>	<b>Reversed</b>
1, 2, 4, 7, 8, 11–13	103	Zhenjiang, Sedlak '967, Ito		1, 2, 4, 7, 8, 11–13
9, 10	103	Zhenjiang, Sedlak '967, Ito, Sedlak '002		9, 10
<b>Overall Outcome</b>				1, 2, 4, 7–13

REVERSED