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Datasheet for the decision of 5 March 2021

Case Number: T 2135/18 - 3.3.05

Application Number: 12711246.4

Publication Number: 2681160

IPC: C02F11/10, C10G3/00

Language of the proceedings: EN

Title of invention:
INTEGRATED PROCESS FOR THE PRODUCTION OF BIO-OIL FROM SLUDGE COMING FROM A WASTEWATER PURIFICATION PLANT

Applicant:
ENI S.p.A.

Headword:
Bio-Oil from sludge/ENI

Relevant legal provisions:
RPBA 2020 Art. 13(2)
EPC Art. 56

Keyword:
Amendment after summons - taken into account (yes)
Inventive step - (no) - auxiliary request (no)

Decisions cited:
T 0106/84

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 2135/18 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 5 March 2021

Appellant: (Applicant)	ENI S.p.A. Piazzale E. Mattei 1 00144 Rome (IT)
Representative:	Cernuzzi, Daniele Studio Torta S.p.A. Via Viotti, 9 10121 Torino (IT)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 26 March 2018 refusing European patent application No. 12711246.4 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	E. Bendl
Members:	S. Besselmann
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. This appeal lies from the decision of the examining division to refuse European patent application No. 12711246.4. The patent application concerns an integrated process for the production of bio-oil from sludge coming from a wastewater purification plant.

II. The following documents are of relevance.

D3 WO 2004/087619 A2 (AB-CWT LLC [US]), 14 October 2004

D8 P. M. Molton et al., "STORS: The Sludge-to-Oil Reactor System", Project Summary EPA/600/S2-86/034, June 1986

III. The examining division found that the subject-matter of the claims of the then pending request, which was filed during the oral proceedings before the examining division, lacked an inventive step in view of D3 as the closest prior art (Article 56 EPC).

IV. With its statement of grounds of appeal, the applicant (appellant) submitted the claims dealt with by the examining division as its main request and in addition filed two auxiliary requests. It also filed experimental results.

In reply to the preliminary opinion of the board, the appellant filed on 7 January 2021 further amended claims as auxiliary requests 3 and 4 to replace the main request and auxiliary requests 1-2, if admitted. It also re-submitted the following three post-published

documents that it had already filed during examination proceedings (point 9 of the impugned decision).

D5 S.R. Shanmugam et al., "Treatment of aqueous phase of bio-oil by granular activated carbon and evaluation of biogas production", Bioresource Technology 223 (2017) 115

D6 R. Posmanik et al., "Coupling hydrothermal liquefaction and anaerobic digestion for energy valorization from model biomass feedstocks", Bioresource Technology 233 (2017) 134

D7 A.R.K. Gollakota et al., "A review on hydrothermal liquefaction of biomass", Renewable and Sustainable Energy Reviews 81 (2018) 1378

During the oral proceedings before the board (5 March 2021), the appellant maintained only auxiliary requests 3 and 4 and withdrew all other requests. One of the inventors attended the oral proceedings and gave a presentation on the invention and its comparison with the prior art.

V. Claim 1 of auxiliary request 3 relates to an integrated process for the production of bio-oil from sludge and reads as follows.

"*Integrated process for the production of bio-oil from sludge coming from a wastewater purification plant, comprising the following steps in sequence:*

(a) sending wastewater to a preliminary treatment obtaining oils and/or fats and a first aqueous phase which is sent to said purification plant obtaining sludge, said sludge being selected from primary sludge, biologic sludge produced in purification plants of civil and/or industrial wastewater, or mixtures thereof, and wherein said

sludge is used in a mixture with oily by-products, coming from said preliminary treatment of wastewater;
(b) subjecting the sludge in a mixture with oily by-products obtained in said step (a) to liquefaction obtaining a mixture comprising an oily phase consisting of bio-oil, a solid phase and a second aqueous phase, said liquefaction step (b) being carried out at a temperature ranging from 150°C to 350°C, at a pressure ranging from 5 bar to 170 bar, for a time ranging from 5 minutes to 240 minutes; and separating said oily phase, said solid phase and said second aqueous phase included in the mixture obtained in said step (b) by gravitational separation or filtering or centrifugation;
(c) sending the second aqueous phase obtained in said step (b) and separated from said oily phase and said solid phase directly to said purification plant without subjecting said second aqueous phase to further treatments."

VI. Claim 1 of auxiliary request 4 differs from auxiliary request 3 in that the conditions of the liquefaction step (b) are more narrowly defined (markings are added by the board to show the changes):
"*said liquefaction step (b) being carried out at a temperature ~~ranging from~~of ~~150°C to 350°C,~~ 310°C, at a pressure ~~ranging from 5 bar to 170~~ of 110 bar, for a time ~~ranging from 5 minutes to 240 minutes;~~ of 1 hour*",
and in that the following feature has been added at the end of the claim:
"*whereby said second aqueous phase is equal to 0.03 % in volume compared to the total volume of the wastewater processed in said purification plant.*"

VII. The appellant's arguments as far as relevant for the present decision may be summarised as follows.

The invention provided an integrated process for treating sludge from a wastewater purification plant to produce bio-oil. In comparison to the process known from D3, the invention solved the technical problem of providing an improved process that was more simplified and economical.

D3 neither disclosed an integrated process nor provided any suggestion to send the second aqueous phase back to the same purification plant from which the sludge was obtained. It also taught away from sending the second aqueous phase directly, without any further treatment, to a purification plant. Instead it described an additional, costly concentration treatment.

The second aqueous phase had a high organic content including toxic substances which lowered its degradability in a normal purification plant. It would generally have been considered unsuitable for treatment in the purification plant, as was confirmed by D5-D7. D5, for instance, taught that "the BOAP [bio-oil aqueous phase] cannot be discharged directly into the water stream due to high level of carbon content of this waste".

Document D8 did not contain a clear teaching to directly treat the second aqueous phase but only made an additional "would be" comment that was not supported by evidence. It furthermore dealt with a second aqueous phase that was different, having better characteristics, to in the application at issue. Tests in D8 analysing anaerobic digestibility were negative.

The inventors surprisingly found that the second aqueous phase from the liquefaction step could be sent directly to the purification plant without worsening its performance, as shown in the examples. The examples also showed that no toxic substances accumulated in the sludge hold-up.

Whether there were process conditions in which the amount of contaminants was too high that thus affected the performance of the purification plant was irrelevant because the invention lay in the finding that it was possible in principle, as shown in the examples. The skilled person would have known which process conditions to use.

Sending the second aqueous phase directly to the purification plant might appear simple, but it was this simplicity which should be seen as indicative of an inventive step, in accordance with T 106/84 (Reasons 8.7).

A further difference over D3 was the use of sludge in a mixture with oily by-products coming from the preliminary step. This had the effect of increasing the yield of bio-oil.

Other advantages of the claimed process were the valorisation of the sludge, the minimisation of the amount of solid waste obtained in the wastewater purification process and the possible exploitation of the solid phase resulting from the liquefaction step for the production of heat or energy.

In claim 1 of the lower ranking request, the relative amount of the second aqueous phase in the total wastewater stream was selected so that the contaminant

load would not be detrimental to the purification performance. The skilled person would not have contemplated selecting a predetermined amount of the second aqueous phase to be sent to the purification plant.

VIII. The appellant requested that the contested decision be set aside and that a patent be granted on the basis of the claims submitted as auxiliary request 3 or, alternatively, on the basis of auxiliary request 4, both filed on 7 January 2021.

Reasons for the Decision

2. Article 13(2) RPBA 2020

2.1 Auxiliary requests 3 and 4 were filed after summons to oral proceedings had been issued (summons dated 13 July 2020).

The filing of these requests at this stage of the proceedings had been justified by the appellant. Specifically, auxiliary requests 3 and 4 are similar to the main request and auxiliary request 2, respectively, submitted with the statement of grounds of appeal. They address objections under Articles 123(2) and 84 EPC raised during the appeal proceedings. Auxiliary requests 3 and 4 are intended to replace all previous requests. Admitting these requests thus does not confront the board with any new issues but simplifies the discussion and thus serves procedural economy.

The board therefore comes to the conclusion that these are exceptional circumstances within the meaning of

Article 13(2) RPBA 2020 and admits the claims submitted as auxiliary requests 3 and 4 into the appeal proceedings.

Claims submitted as auxiliary request 3 on 7 January 2021

3. Inventive step (Article 56 EPC)

3.1 The application under consideration concerns an integrated process for the production of bio-oil from sludge coming from a wastewater purification plant.

3.2 Document D3 relates to the processing of waste or low-value products to form useful raw materials, including at least one oil product (paragraph [00029]). The process is applicable to municipal sewage sludge (see e.g. the indicated paragraph and Example 3). D3 therefore relates to a similar purpose and is a suitable starting point for assessing inventive step.

3.3 D3 does not disclose an integrated process comprising the step (c) of sending the second aqueous phase obtained in the step (b) and separated from the oily phase and the solid phase directly to the purification plant without subjecting the second aqueous phase to further treatments.

3.4 According to the application, sending the second aqueous phase directly to the purification plant provides for an efficient and simple management of the aqueous phase obtained from sludge liquefaction, with a consequent reduction of both overall investment and operating costs (paragraph bridging pages 4-5; page 5, second bullet point).

The technical problem addressed by the indicated difference is therefore the provision of a simpler and cheaper process.

3.5 As the solution, the application proposes the claimed integrated process comprising the step (c) of sending the second aqueous phase obtained in the step (b) and separated from the oily phase and the solid phase directly to the purification plant without subjecting the second aqueous phase to further treatments.

3.6 In the appellant's favour, the question of whether this clearly excludes an additional pre-purification step of the second aqueous phase as part of the treatments in the wastewater purification plant is left aside.

3.7 The board has no doubt that the indicated technical problem is solved.

3.8 Read into the process of D3, the proposed solution would require sending the produced water (138) (Figure 1), which corresponds to the second aqueous phase stipulated in the claim at issue, directly to the purification plant from which the sewage sludge was obtained. This would automatically turn the process of D3 into an integrated process within the meaning of claim 1 at issue.

3.9 The skilled person would have learnt from D3 that the produced water (138) from the separation step contains numerous compounds including sulfur- and chlorine-containing materials (paragraph [0071]).

As argued by the appellant, and corroborated by reference to D5-D7, the presence of these contaminants would have raised concerns regarding water quality if

sent to a purification plant. The board has no doubt that such concerns exist in the art. In line with such concerns, D3 teaches that the produced water (138) is preferably diverted for concentration yielding a condensate (having a purity taught to be usually better than that of municipal-strength wastewater) and a concentrate (useful as a liquid fertiliser; paragraph [0071]).

3.10 However, the process according to claim 1 at issue does not avoid the presence of contaminants in the second aqueous phase. In particular, it does not avoid the resultant degradation of the water quality in the purification plant, depending on the amount of contaminants introduced by the second aqueous phase.

This can be taken from Example D provided by the appellant in the statement of grounds of appeal. According to this example, the quality of the purified water decreased after about 30 days when the proportion of the second aqueous phase amounted to 0.5 vol.-% (value presented during the oral proceedings) of the total wastewater stream sent to the purification plant, and the quality of the water was not acceptable.

Example D falls fully within the scope of the claim. The claim needs to be considered as a whole. It is not sufficient that specific conditions be identified in which the water quality was maintained (Examples 2 and 3).

3.11 It would have been readily foreseeable for the skilled person that sending the second phase directly, without further purification, to the water purification plant simplifies the process and saves the costs of an additional purification step.

It is the very purpose of a wastewater purification plant to receive wastewater streams. The skilled person, having to dispose of a wastewater stream, would therefore generally have taken this option into account. The mere idea of sending a wastewater stream to a purification plant is independent of any statutory framework regulating this or concerns about water quality.

The case law according to T 106/84 (Reasons, 8.7), cited by the appellant, is therefore not relevant to this case.

3.12 The application mentions various other advantages of the claimed process (list on pages 5-6). However, these are due to using sludge and solid waste as a feedstock for a liquefaction step, and are therefore also obtained in D3 where municipal sewage waste (namely sewage sludge and grease-trap waste) is converted to oil (Example 3). Similarly, the process of D3 also produces a reacted solid product, enabling its exploitation.

Moreover, D3 explicitly mentions that the "municipal sewage waste" comprises 75% sewage sludge and 25% grease-trap waste (Example 3, paragraph [0157]). This implies a "grease-trap" as a preliminary treatment. The grease is an "oily by-product". Using the grease-trap waste as part of the feedstock for the liquefaction step naturally leads to the effect described in the instant application (paragraph bridging pages 5-6, last bullet point), namely increasing the amount of bio-oil produced compared to using sewage sludge alone, and avoiding the disposal costs for the grease-trap waste.

The reference to "municipal sewage waste" (Example 3) in general suggests that its explicitly mentioned components, namely the sewage sludge and the grease-trap waste, are from the same municipal sewage system, i.e. from one wastewater stream. In any case, this would have been a straightforward choice. It is irrelevant for the yield in bio-oil whether the grease-trap waste is derived from the same or a different wastewater stream.

3.13 Therefore, sending the second phase directly to the water purification plant is at the expense of degrading water quality and thus merely constitutes a foreseeable worsening of the prior art process. It is not set off by any unexpected technical effect other than the foreseeable simplification.

A foreseeable disadvantageous modification of the prior art does not normally involve any inventive step (Case Law of the Boards of Appeal of the EPO, 9th edition, 2019, I.D.9.19.1).

3.14 In line with the impugned decision, the claimed process furthermore differs from D3 in that the time period of the liquefaction step (b) is from 5 to 240 minutes. The appellant did not bring forward any arguments regarding a possible contribution of this difference to inventive step.

The board concurs with the examining division that the skilled person would have readily selected a suitable time period for the liquefaction step and would in particular have been guided by the disclosure of D3, which mentions a typical reaction time of 5 to 60 minutes for a conditioned feed slurry (paragraph

[0091]), to select a time period within the claimed range.

3.15 The claimed process therefore does not involve an inventive step.

Claims submitted as auxiliary request 4 on 7 January 2021

4. Amendments

4.1 The question of whether the amendments comply with the requirements of Articles 123(2) and 84 EPC can be left open because they do not overcome the finding of lack of inventive step.

5. Inventive step

5.1 Document D3 continues to be the closest prior art. The objective technical problem also remains the same, i.e. the provision of a simpler and cheaper process.

5.2 Claim 1 now specifies that the second aqueous phase is equal to 0.03 % in volume compared to the total volume of the wastewater processed in the purification plant. In addition, the liquefaction step (b) is limited to the time, pressure and temperature used in Examples 2 and 3.

5.3 It therefore needs to be assessed whether the finding that the simplification of the process is at the expense of degrading water quality still applies to the claims of this auxiliary request.

5.3.1 As argued by the appellant, the second aqueous phase contains contaminants generated in the liquefaction step that are not degradable in the wastewater purification plant. They pose a risk to the quality of the purified water.

5.3.2 The examples provided with the statement of grounds of appeal show that the performance of the purification plant could only be maintained when the amount of contaminants introduced by the second aqueous phase was very low (Examples A-C; see also Examples 2 and 3 of the application). This performance was not maintained when the amount of the second aqueous phase was increased to 0.5 vol.-% in relation to the total wastewater (Example D, as indicated under point 3.10 above).

5.3.3 However, limiting the contaminants' input into the wastewater stream to a very low amount is not only a function of the proportion of the second aqueous phase in relation to the total wastewater stream but also of the type and concentration of contaminants in the second aqueous phase.

The contaminants are generated in the liquefaction step. Thus, their type and amount depends on the feedstock for the liquefaction step. The reference to "bio-oil" as the desired product does not impose any clear limitation on the composition of the feedstock for the liquefaction step. By contrast, the claims explicitly foresee using sludge from industrial wastewater and the addition of various kinds of waste material (claims 1 and 2), and hence using a more heavily contaminated feedstock in the liquefaction step than in the case of Example D, bringing about a higher risk of contamination. The feedstock for the

liquefaction step in Example D was municipal sewage sludge with a relatively low addition of oily by-products, as follows from the reference to Example 4 and thus to Example 2.

Moreover, continuously recycling the contaminants with the second aqueous phase to the water purification process in which they are not degradable leads to an accumulation over time. The invention examples, in which the water quality remained stable, only cover a time period of 45 days. By contrast, it follows from Example D, in which the water quality degraded after about 30 days, that the time period is a relevant factor.

5.3.4 In the light of the above, it cannot be concluded that the appellant's finding that it was able to use the second aqueous phase as a co-stream in a wastewater purification plant without performing any other operation under specific conditions, as shown in Examples 2 and 3, can be generalised to all processes and kinds of wastewater encompassed by the claims at issue.

5.3.5 The conclusion that the simplification of the process is at the expense of degrading water quality therefore also applies to the claims of this request.

5.4 Moreover, the skilled person would have been aware of document D8, which describes a sludge-to-oil reactor (abstract). According to D8, no problem should occur in recycling the wastewater from the liquefaction unit (i.e. the second aqueous phase) with the primary sludge input into an aerobic treatment plant as the additional loading would be minor (page 4, middle column, first full paragraph).

Even if this statement in D8 only expresses the authors' expectation, it would have prompted the skilled person to send the second aqueous phase from the liquefaction step to an aerobic treatment as long as it represents only a minor proportion of the water treated.

This general consideration is independent of the specific composition of the second aqueous phase, with the understanding that the tolerable proportion will be lower if its contaminant load is higher.

5.5 The claim at issue does not specify which specific wastewater purification steps are performed in the purification plant nor to which step the second aqueous phase is sent. It is therefore irrelevant that D8 additionally indicates that the result of a preliminary experiment to determine anaerobic digestibility of the wastewater was negative (page 4, middle column, first full paragraph), with no anaerobic treatment being required in the claimed process.

5.6 The appellant did not invoke any technical effect related to the conditions (temperature, pressure, time) of the liquefaction step, nor can any be derived from the application. It cannot even be assumed that these conditions have been specially adapted to the various liquefaction feedstocks encompassed by claims 1-2.

The skilled person would readily have selected suitable conditions for the liquefaction step within the general teaching of D3 (see paragraph [0094] and claims 7 and 9) without the need of performing an inventive step.

5.7 For these reasons, the claimed process does not involve any inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated