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**Datasheet for the decision
of 30 April 2014**

Case Number: T 0146/10 - 3.3.05

Application Number: 01992687.2

Publication Number: 1315675

IPC: C02F1/28

Language of the proceedings: EN

Title of invention:

METHOD FOR REMEDIATION OF AQUIFERS

Patent Proprietor:

Solutions-IES, Inc.

Opponent:

Remediation and Natural Attenuation Services Inc.

Headword:

Remediation of aquifers/SOLUTIONS-IES

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - all requests (no)
Prior art document in a more general field to be considered
(yes) - reasonable expectation of success (yes)

Decisions cited:

T 0195/84, T 0176/84, T 0249/88, T 0877/08

Catchword:



**Beschwerdekammern
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Chambres de recours**

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Case Number: T 0146/10 - 3.3.05

**D E C I S I O N
of Technical Board of Appeal 3.3.05
of 30 April 2014**

Appellant:
(Patent Proprietor)

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Decision under appeal:

**Decision of the Opposition Division of the
European Patent Office posted on 1 December 2009
revoking European patent No. 1315675 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chairman: G. Rath
Members: A. Haderlein
P. Guntz

Summary of Facts and Submissions

- I. The present appeal lies from the decision of the opposition division to revoke European patent EP-B-1 315 675. The patent in suit concerns a method for remediation of aquifers.
- II. The opposition was filed on the grounds of lack of sufficiency (Article 100(b) EPC), added subject-matter (Article 100(c) EPC) and lack of novelty and inventive step (Article 100(a) EPC).
- III. The opposition division's decision was based *inter alia* on the following documents:
- D1: Zenker, M.J. et al., Insoluble substrates for reductive dehalogenation in permeable reactive barriers, in Bioremediation and Phytoremediation of Chlorinated and Recalcitrant Compounds, The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 22-25, 2000.
- D5: Soo, H. and Radke, C.J., Flow of Dilute, Stable Liquid and Solid Dispersions in Underground Porous Media, AIChE Journal, Vol. 31, No. 11, 1926-1928.
- D6: Soo, H. and Radke, C.J., The Flow Mechanism of Dilute, Stable Emulsions in Porous Media, Ind. Eng. Chem. Fundam. 1984, 23, 342-347.
- IV. In its decision, the opposition division found that the main request (the patent as granted and as corrected according to the decision of the examining division

dated 6 February 2007) and the auxiliary request filed by the proprietor (hereinafter: appellant) at the oral proceedings held on 3 November 2009 complied with the requirements of sufficiency of disclosure and novelty and did not contain added subject-matter, whereas it did not comply with the requirement of inventive step. In particular, it found that the subject-matter of claim 1 of the main request and of the auxiliary request did not involve an inventive step in view of D1 in combination with D5 and D6.

- V. The appellant's notice of appeal and its statement of grounds of appeal were received on 22 January 2010 and 9 April 2010, respectively. The appellant maintained its main request and requested oral proceedings before a final decision was made. It filed the following document:

D5/D6a: Declaration of Professor Clayton J. Radke

The reply by the opponent (respondent) was received on 12 July 2010. It maintained its objection of lack of novelty and, in the alternative, its objection of lack of inventive step based among other things on a combination of D1 and D5 or D6. It also argued that the claims as granted contained added subject-matter. In support of its objections, it submitted additional documents.

- VI. Under cover of its letter dated 31 March 2014, the appellant submitted three auxiliary requests and confirmed its main request, i.e. the claims as granted and as corrected according to the decision of the examining division dated 6 February 2007.

VII. Claim 1 of the main request reads as follows:

"1. A method for remediating a selected aquifer in a sediment having a mean pore size to reduce contaminants in the aquifer, comprising treating the aquifer with a selected amount of an oil microemulsion having an average droplet size less than the mean pore size of the sediment."

VIII. Claim 1 of auxiliary requests reads as follows (amendments with respect to the main request being underlined):

Auxiliary request 1

"1. A method for remediating a selected aquifer in a sediment having a mean pore size to reduce contaminants in the aquifer, comprising:
a) evaluating the aquifer for contaminant identity and location; and
b) treating the aquifer with a selected amount of an oil microemulsion having an average droplet size less than the mean pore size of the sediment."

Auxiliary request 2

"1. A method for remediating a selected aquifer in a sediment having a mean pore size to reduce contaminants in the aquifer, comprising:
a) evaluating the aquifer for contaminant identity and location,
b) determining whether aquifer pretreatment should be done, and if so, pretreating the aquifer,
c) treating the aquifer with a selected amount of an oil microemulsion having an average droplet size less than the mean pore size of the sediment,

d) determining whether aquifer post-treatment should be done, and if so, post-treating the aquifer; and
e) monitoring the aquifer to determine if remediation has been accomplished."

Auxiliary request 3

"1. A method for remediating a selected aquifer in a sediment having a mean pore size to reduce contaminants in the aquifer, comprising treating the aquifer with a selected amount of an oil microemulsion having an average droplet size less than the mean pore size of the sediment, and wherein the microemulsion is an emulsion having an average droplet size of less than 1 micron in diameter."

IX. Oral proceedings before the board took place on 30 April 2014.

X. The appellant essentially argued as follows:

Although D1 did not disclose whether the pilot test was successful, the method according to claim 1 of the main request differed from the one disclosed in D1 only by the use of an emulsion with an average droplet size less than the mean pore size of the sediment. Starting from D1 as the closest prior art, the objective technical problem to be solved was how to obtain effective distribution of the emulsion from the point of injection while creating an immobile barrier, i.e. one where the organic substrate is not carried away by the ground water. Figures 2 and 3 of the patent in suit showed that this problem was effectively solved. In D1 the problem of effective distribution of the emulsion was already solved. As there was nothing in D1 to indicate to the reader that more widespread

distribution was required, the skilled reader of D1 would not look elsewhere for further teaching on the subject. D1 also taught that the use of permeable reactive barriers was more advantageous than flushing using a soluble organic substrate, leading to the organic substrate not staying in place. D1 therefore taught that a steady-state flow regime was not desirable. As evidenced by the declaration provided by Professor Radke, D6 was an academic study which had been devised with the field of oil recovery in mind and, thus, D6 did not relate to the same technical field. Moreover, the study of D6 had been conducted in a specific and simplified environment, meaning that the skilled person was not in a position to directly transfer the conclusions to aquifer remediation in a natural environment. D6 suggested using bigger droplet sizes in order to have increased retention. D6 also taught to use smaller droplet sizes in order to achieve a steady-state flow regime, whereas D1 taught not to use a steady-state flow regime. Thus, the prior art taught away from the solution proposed in the patent in suit.

Auxiliary requests 1 and 2 had been submitted in order to address objections under Article 123(2) EPC raised by the respondent. They were not intended to further distinguish the subject-matter over the disclosure of D1. They therefore complied with the requirement of inventive step for the same reasons as for the main request.

Auxiliary request 3 was aimed at further restricting the claimed subject-matter over the state of the art. As neither D1 nor D5 nor D6 disclosed an average droplet size of less than 1 micron, the skilled person would not have arrived at the subject-matter of claim 1

of auxiliary request 3 even when combining D1 and D5 or D6.

XI. The respondent essentially argued as follows:

The main request contained added subject-matter.

The subject-matter of claim 1 of the main request did not involve an inventive step, in particular in view of the combination of D1 and D6. D6 was not restricted to oil recovery and contained teachings of a fundamental nature. According to T 195/84, the skilled person would also consider the state of the art in a more general field dealing with the solution of a general technical problem. D6 dealt with the general technical problem of emulsion distribution in porous media; it constituted such prior art in a more general field and could therefore be readily combined with D1. According to D6, permeability reductions during emulsion flow were caused by droplet capture mechanisms similar to particle filtration. It was fundamental knowledge that in order to pass through a filter, the matter to pass must be smaller in size than the pores of the filter.

Auxiliary requests 1 to 3 were late-filed and were not admissible pursuant to Article 13 RPBA. In any event, the additional features of auxiliary requests 1 and 2 failed to further distinguish the claimed subject-matter from D1, and thus the claimed subject-matter did not involve an inventive step for the same reasons as for the main request. Although neither D1 nor D6 disclosed a mean droplet size of lower than 1 micron, the teaching of D6 was of a general nature and thus the skilled person would choose such a droplet size if the pore size of the aquifer to be remediated was 1 micron. Hence, the subject-matter of claim 1 of auxiliary

request 3 also did not involve an inventive step.

XII. Requests

The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request or of one of auxiliary requests 1 to 3, all requests having been submitted with the letter of 31 March 2014.

XIII. The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Main request - inventive step

1.1 The invention concerns a method for remediation of aquifers.

1.2 The appellant considered D1 as the closest prior art whereas the respondent considered it to be either of two documents, one of which being D1. In view of this, the board considers it appropriate to start from document D1 as the closest prior art.

D1 discloses a method comprising treating a selected aquifer in a sediment having a mean pore size with a selected amount of an oil microemulsion (see first paragraph in section "INTRODUCTION" on page 47 and section "FIELD PILOT TEST").

While conceding that the sole difference of the method according to claim 1 of the main request resided in the mean droplet size to mean pore size ratio, the appellant was of the opinion that D1 did not disclose whether the field pilot test mentioned therein had

actually been successful. The board concludes from these submissions that the appellant does not contest that D1 nevertheless discloses a method for remediating a selected aquifer in a sediment. It is true that the section "FIELD PILOT TEST" in D1 does not mention explicitly that the remediation was successful. However, in the section "LABORATORY STUDIES" of D1 a method for remediation to reduce contaminants is disclosed, since the laboratory studies using the same organic substrate, i.e. soy bean oil, led to biodegradation as indicated in Figure 1 of D1. Thus, the part of D1 dealing with the pilot test does at least implicitly disclose a method for remediating a selected aquifer in a sediment to successfully reduce contaminants.

- 1.3 According to the patent in suit the problem resided in the provision of a safe, low-cost, effective method of bioremediation of aquifers. Moreover, the problem also focused on an improved distribution of the oil laterally away from the injection points and entrainment of the oil micro-droplets into the effective pore space of the aquifer material while creating an immobile organic substrate (see paragraph [0021]).
- 1.4 As a solution to said problem, the patent in suit proposes a method according to claim 1 of the main request characterised in that the microemulsion is an emulsion having an average droplet size of less than the mean pore size of the sediment.
- 1.5 As to the success of the solution, the board has no doubts that the method according to claim 1 of the main request is a safe, low-cost and effective method of bioremediation of aquifers. It is also at least

plausible that it results in an improved distribution of the oil and entrainment of the oil micro-droplets into the effective pore space of the aquifer material. Also, considering the evidence at hand such as D6, the board considers it established that even at average droplet sizes much smaller than the average pore size the oil will be captured by the pores and/or crevices, resulting in an immobile organic substrate or permeable reactive barrier. For instance, in Figure 6 of D6 one can see that even at average droplet sizes much smaller than the mean pore size (e.g. 2 microns compared to 17 or 29 microns, see section "Porous Media"), the droplets are retained in the porous medium to some extent since the breakthrough, i.e. the point in time where the amount of oil entering the sandpack equals the amount of oil leaving the sandpack, only takes place after some time (corresponding to a certain oil volume expressed as pore volume).

The problem stated *supra* at 1.3 is thus solved and does not need to be reformulated.

1.6 It remains to be decided whether the proposed solution is obvious in view of the cited prior art.

1.6.1 D6 teaches that pores are not blocked if the droplets are smaller than the throat size of the pores (see the sentence bridging the left-hand and the right-hand column on page 347).

Moreover, D6 also discloses the relationship between droplet retention leading to permeability reduction on the one hand and breakthrough behaviour in a porous medium on the other hand. In fact, Figure 6 of D6 shows permeability and breakthrough curves as a function of the amount of oil in the emulsion, expressed as pore

volume. The mean droplet size was between 2.1 and 6.1 microns. The mean pore volume of the sandpack is not explicitly disclosed but must either be 17.3 or 29.5 microns (see page 344, left-hand column, section "Porous Media", lines 8 and 9, and section "Flow Experiments", lines 1 *et seqq.*). What is clear from Figure 6 is that even at mean droplet sizes which are much smaller than the mean pore size (e.g. 2.1 microns versus 17.3 or 29.5 microns) droplets are caught in the pores and crevices of the sandpack leading to decreased permeability and to a breakthrough only after a certain number of droplets are retained in the sandpack. The bigger the droplets, the higher the retention (cf. page 347, right-hand column, second full paragraph).

1.6.2 Thus, the skilled person faced with the problem of improved distribution of oil and entrainment of the oil micro-droplets into the effective pore space of the aquifer material while creating an immobile organic substrate and faced with the teachings of D6 will choose an average droplet size less than the mean pore size of the sediment. In fact, he will choose one which is much smaller than the mean pore size of the sediment, i.e. in the order of at most 0.58 times the average pore size (maximum average droplet size of 10 microns, see page 343, right-hand column, last paragraph, compared to a mean pore size of at least 17.3 microns, see page 344, left-hand column, section "Porous Media", lines 8 and 9).

1.6.3 It is true that D6 teaches that bigger droplets lead to higher retention (see Fig. 6 and page 347, left-hand column, second full paragraph), as pointed out by the appellant. It is also true that the skilled person faced with the problem to be solved would still aim at an immobilisation of the droplets, i.e. a certain

degree of retention. This, however, does not mean that he would choose droplet sizes which are greater than the average pore size. Rather, he would recognise that all emulsions used in D6 have an average droplet size clearly below the average pore size of the porous media used and that to increase retention, i.e. immobilisation of the emulsion, he would have to increase the average droplet size while choosing an average droplet size clearly below the average pore size. He would also note that even at the lowest droplet sizes used in D6 a certain degree of retention is achieved (see Figure 6, the curves for a mean droplet size of 2.1 microns).

- 1.6.4 The appellant also argued that the skilled person would refrain from adopting a steady-state flow as disclosed in D6, since he would want to create an immobilised organic phase, while steady-state flow would lead to the organic phase being washed away.

This argument must fail, as D6 clearly teaches that steady flow, i.e. a flow regime wherein the permeability remains constant (see Figure 6 and page 344, right-hand column, last full paragraph), is achieved only after a certain time (expressed in pore volume oil) and with any droplet size, i.e. also with the smallest droplet size of 2.1 microns. This means that in order to have the emulsion distribute further away from the injection wells, one needs first to fill the pore walls and crevices of the pores in the vicinity of the injection wells before it is possible to have unimpeded emulsion flow towards an area more remote from the injection wells, whereby a steady state is necessarily established in the vicinity of the injection wells.

- 1.6.5 According to the appellant, the skilled person would not have combined D1 and D6, as D1 did not report that the pilot tests had actually been successful.

This argument must fail as D1 at least implicitly discloses that the pilot tests led to remediation and to the reduction of contaminants at least to some extent (cf. at 1.2 *supra*, third paragraph).

Moreover, according to the appellant there was no indication in D1 to the reader that a more widespread distribution was required or would be necessary. There would not have been any motivation for the skilled person to consider ways to distribute the emulsion further. This argument is, however, insufficient to show that the skilled person would not have been motivated to combine the teachings of D1 and D6. Rather, what needs to be determined is whether the skilled person would have combined the teachings of D1 and D6 in order to solve the problem posed at 1.3 *supra*. And, as shown *supra* at 1.6.1 and 1.6.2, the skilled person would indeed have combined the teachings of D1 and D6.

- 1.6.6 According to a further argument of the appellant, the skilled person would not have adopted the teachings of D6 as it was related to a technical field different from that of D1.

D6 relates to flow mechanisms of dilute, stable emulsions in porous media (see title of D6). D1, too, deals with flow mechanisms of emulsions in porous media since a microemulsion is injected into an aquifer, creating some sort of flow in a porous medium. The microemulsions in D1 are also dilute and stable at least to some extent (see page 51, first paragraph,

"soybean oil-in-water emulsion"). Thus, D6 concerns a technical field which is more general than that of the patent in suit. This is confirmed by the declaration D5/D6a of one of the authors of D6 stating that, albeit having potential relevance to oil recovery, the study of D6 was of a fundamental nature (see item 8 on page 2 of D5/D6a). According to the case law of the boards of appeal, the mere fact that a document relates to a more general technical field than the closest prior art does not prevent the skilled person from combining the teachings of that document and the closest prior art (see T 195/84 of 10 October 1985, reasons 8.4, and T 176/84 of 22 November 1985, reasons 5.3.1). Hence, the skilled person would not have refrained from combining the teachings of D1 and of D6 only because D6 is not from the same specific field as D1.

- 1.6.7 The appellant also argued that the study disclosed in D6 was carried out in a pure sandpack, washed clean with acid and base. Hence, being aware that factors such as pH, changes in sediment type or soil charges would dramatically affect the behaviour of an injected emulsion, the skilled person would not have applied the teachings of D6 to the method of D1.

The board does not share this view. It is true that the sandpack used in D6 served as a model environment (cf. declaration D5/D6a, items 12 to 14). It is, however, normal practice in many areas of technology, including bioremediation technology, to study a phenomenon in an ideal model before applying the findings to the large-scale environment, e.g. to the site to be remediated. Thus, the skilled person would have followed the teaching of D6 with a reasonable expectation of success (see T 249/88 of 14 February 1989, reasons 8, cited for

example in T 877/08 of 5 May 2009, reasons 4.7).

1.6.8 It follows from the above that the subject-matter of claim 1 of the main request does not comply with the requirement of inventive step set forth in Article 52(1) in combination with Article 56 EPC.

2. Auxiliary requests 1 and 2 - inventive step

As submitted by the appellant during the oral proceedings before the board, the additional features contained in claim 1 of auxiliary request 1 and of auxiliary request 2 were intended to overcome the respondent's objections under Article 100(c) EPC and did not aim at establishing a further distinction over the disclosure of D1. The appellant acknowledged that these features were at least implicitly disclosed in D1. The respondent was of the same opinion.

It follows that the subject-matter of claim 1 of these requests does not comply with the requirement of inventive step set forth in Article 52(1) in combination with Article 56 EPC for the same reasons as for the subject-matter of claim 1 of the main request.

3. Auxiliary request 3 - inventive step

The board refers to the reasoning set out for the main request.

According to the appellant, while the problem to be solved remained the same for auxiliary request 3 as for the main request, the skilled person would not arrive at the subject-matter of claim 1 of auxiliary request 3 even if he combined the teachings of D1 and D6, since neither of these documents disclosed average droplet

sizes of less than 1 micron in diameter.

It is true that D1 does not disclose any value for the average droplet size and D6 only discloses average droplet sizes ranging from 2 to 10 microns (see page 343, right-hand column, last paragraph). The teaching of D1, however, goes beyond the absolute values for the average droplet size. As mentioned *supra* at 1.6.2 and 1.6.3 the skilled person derives from the disclosure of D6 the general teaching that the average droplet size should be clearly below the mean pore size of the sediment to be treated and that this teaching is not strictly limited to mean droplet sizes ranging from 2 to 10 microns. As a result, the skilled person would also envisage average droplet sizes below 1 micron when faced with a sediment with a mean pore size of for instance 1 micron. For the sake of completeness it should also be borne in mind that D6 discloses droplet sizes of "around 1" micron (see page 343, right-hand column, last paragraph), i.e. it already discloses droplet sizes of the order of magnitude of the average droplet size required in claim 1 of auxiliary request 3.

It follows from the above that the subject-matter of claim 1 of auxiliary request 3 does not comply with the requirement of inventive step set forth in Article 52(1) in combination with Article 56 EPC.

4. Since none of appellant's requests comply with the requirement of inventive step, the question of added subject-matter and the admissibility of the auxiliary requests can be left open.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



C. Vodz

G. Rath

Decision electronically authenticated