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**D E C I S I O N**  
**of 11 September 2003**

**Case Number:** T 0177/01 - 3.3.1

**Application Number:** 95104522.8

**Publication Number:** 0675106

**IPC:** C07C 303/16

**Language of the proceedings:** EN

**Title of invention:**

A process for the preparation of alkane sulfonic acid and  
alkane sulfonyl chloride

**Patentee:**

ELF ATOCHEM NORTH AMERICA, INC.

**Opponent:**

Phillips Petroleum Company

**Headword:**

Sulfonic acid/ELF

**Relevant legal provisions:**

EPC Art. 54, 56, 123(2) and (3)

**Keyword:**

"Inventive step (yes) - formulation of the problem on the  
basis of technical results achieved vis-à-vis closest prior  
art - problem not addressed in further state of the art - non-  
obvious solution"

**Decisions cited:**

T 0001/80, T 0020/81, T 0024/81, T 0001/83, T 0099/85,  
T 0229/85, T 0248/85, T 0422/93

**Catchword:**

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Case Number: T 0177/01 - 3.3.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 11 September 2003

**Appellant:** ELF ATOCHEM NORTH AMERICA, INC.  
(Proprietor of the patent) 2000 Market Street  
Philadelphia,  
Pennsylvania 19103-3222 (US)

**Representative:** Kraus, Walter, Dr.  
Patentanwälte Kraus, Weisert & Partner  
Thomas-Wimmer-Ring 15  
D-80539 München (DE)

**Respondent:** Phillips Petroleum Company  
(Opponent) Bartlesville,  
Oklahoma 74004 (US)

**Representative:** Ricker, Mathisa, Dr. Dipl.-Chem.  
Patent- und Rechtsanwälte  
Bardehle Pagenberg Dost Altenburg Geissler  
Postfach 86 06 20  
D-81633 München (DE)

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 13 December 2000  
revoking European patent No. 0675106 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** A. J. Nuss  
**Members:** R. Freimuth  
R. T. Menapace

## Summary of Facts and Submissions

- I. The Appellant (Proprietor of the patent) lodged an appeal against the decision of the Opposition Division posted on 13 December 2000 revoking European patent No. 675 106 and filed a written statement setting out the grounds of appeal on 19 April 2001.
- II. Notice of Opposition had been filed by the Respondent (Opponent) requesting revocation of the patent in suit in its entirety for lack of novelty and of inventive step based *inter alia* on the documents
- (4) GB-A-1 350 328 and
- (5) Brochure "Static Mixing Technology", Koch Engineering Co. Inc., 1991.
- III. The decision under appeal was based on an amended set of eight claims submitted on 23 August 2000, claim 1 reading as follows:
- "1. A process for the preparation of a product consisting essentially of alkane sulfonic acid comprising continuously reacting, at a temperature of from 85°C to 115°C, a compound of the formula  $RSX$ , where  $X$  is hydrogen or a radical of the formula- $SR^1$  and  $R$  and  $R^1$  are alkyl groups having one to 20 carbon atoms, with at least a stoichiometric amount of chlorine in a reaction zone free of moving, mechanical agitating means and containing aqueous hydrochloric acid at a reactant feedrate at least sufficient to achieve a vigorous evolution of hydrochloride gas, passing the contents of said reaction zone through, and in contact

with stationary mixing elements to promote plug-flow, withdrawing hydrochloride gas, and separately withdrawing said product from the reactor."

The Opposition Division held that the claimed invention was novel, but did not involve an inventive step. The cited state of the art did not anticipate the subject-matter of the patent in suit since it did not disclose the use of a reactor having stationary mixing elements to promote plug flow in a process for preparing alkane sulfonic acid. In the assessment of inventive step document (4) was considered as closest prior art. The process of that document differed from that according to claim 1 only in the presence of stationary mixing elements promoting plug-flow in the reaction zone. The advantages associated with using stationary mixing elements in the process were derivable from document (5). The advantage of reducing oxidizable impurities was implicitly included in the section entitled plug-flow of that document. The oxidizable impurities being unreacted starting materials and intermediates were therefore indicative for an incomplete reaction. Document (5) explained that in an empty pipe, as used in document (4), the material was not fully reacted; using static mixing elements obviated that problem, and thus also must reduce the amount of unreacted material exiting the reactor. Therefore the claimed invention was obvious.

- IV. The Appellant started the assessment of inventive step from document (4) as closest prior art. The use of a static mixing element in the claimed invention produced technical effects and advantages vis-à-vis that state of the art, in particular the reduction of oxidizable

impurities in the alkane sulfonic acid. Document (5) did not suggest the use of static mixing elements for achieving that improvement. This document did not give any hint to provide alkane sulfonic acid with substantially reduced amounts of oxidizable impurities. The skilled person would not combine document (5) with document (4) in order to solve this technical problem since document (5) was not concerned therewith.

- V. The Respondent (Opponent) acknowledged that document (4) was the closest prior art in the assessment of inventive step. The object of the patent in suit in view of that document could only be seen in providing an alternative method for the preparation of alkane sulfonic acid using mixing elements. Taking into account the advantage of reducing oxidizable impurities, that effect was due to completely reacting and, thus, thoroughly mixing the components since the oxidizable impurities were unreacted starting materials and intermediates. Hence, the problem underlying the patent in suit was the provision of improved mixing so that the oxidizable impurities reacted further. Moreover, the patent in suit aimed indeed at promoting plug-flow by thoroughly mixing thereby overcoming the unsatisfactorily mixed turbulent flow in the process of document (4) which was the reason for the presence of oxidizable impurities. The skilled person who had the object of improving a continuous chemical reaction like the preparation of alkane sulfonic acid and looking at it from the aspect to promote plug-flow would use stationary mixing elements, for example those disclosed in document (5). This document explained that static mixing units induced radial mixing and provided plug-flow necessary to successfully perform continuous

chemical reactions; it taught further that static mixing elements achieved high-efficiency mixing. Therefore document (5) had a clear and unmistakable reference to processes with continuous chemical reactions like document (4) and so it was more than obvious to combine these two documents. According to the teaching of document (5) the advantage of reducing the oxidizable impurities was to be attributed to the static mixing elements promoting plug-flow and improving the efficiency of mixing. Thus, this advantage was derivable from document (5) rendering the subject-matter of claim 1 obvious.

VI. The Appellant requested that the decision under appeal be set aside and the patent be maintained in the form as amended according to the request submitted on 23 August 2000.

The Respondent requested that the appeal be dismissed.

VII. At the end of the oral proceedings held on 11 September 2003 the decision of the Board was announced.

### **Reasons for the Decision**

1. The appeal is admissible.

2. *Amendments (Article 123 EPC)*

In process claim 1 the feature of claim 5 as granted, i.e. a reaction temperature of from 85°C to 115°C, has been incorporated into granted claim 1. In apparatus claim 7 the feature of granted claim 17, i.e. the

particular shape of the static mixing elements, has been added. Those amendments find support in claims 5 and 17 of the application as filed, respectively, and, thus, comply with the requirements of Article 123(2) EPC. Furthermore, the alternative preparation of alkane sulfonyl chloride has been deleted from the process claims as granted which amendment does not generate subject-matter which extends beyond the content of the application as filed.

Those amendments of the claims as granted bring about a restriction of the scope of the claims, and therefore of the protection conferred thereby, which is in keeping with the requirements of Article 123(3) EPC.

3. *Novelty*

The appealed decision found the subject-matter of the claims as amended to be novel (cf. point III *supra*); the Appellant and the Respondent concurred with that finding at the oral proceedings before the Board. Nor does the Board see any reason to take a different view. Hence, it is unnecessary to go into more detail in this respect.

4. *Inventive step*

Thus, the sole issue arising from this appeal consists in deciding whether or not the subject-matter of the claims of the patent in suit as amended involves an inventive step.

4.1 According to the established jurisprudence of the Boards of Appeal it is necessary, in order to assess

inventive step, to establish the closest state of the art, to determine the technical results or effects successfully achieved by the claimed invention vis-à-vis the closest state of the art, to define the technical problem to be solved as the object of the invention to achieve these results or effects, and to examine the obviousness of the claimed solution to this problem in view of the state of the art (see decisions T 1/80, OJ EPO 1981, 206, points 3, 6, 8, 11 of the reasons; T 20/81, OJ EPO 1982, page 217, point 3 of the reasons; T 24/81, OJ EPO 1983, 133, point 4 of the reasons; T 248/85, OJ EPO 1986, 262, point 9.1 of the reasons). This "problem-solution approach" ensures assessing inventive step on an objective basis.

- 4.2 The patent in suit is directed to a process for preparing alkane sulfonic acid by continuously reacting a thio-compound with chlorine in a reaction zone free of mechanical agitating means containing aqueous hydrochloric acid thereby achieving a vigorous evolution of hydrogen chloride gas and withdrawing separately that gas and the alkane sulfonic acid.

A similar process already belongs to the state of the art in that document (4) discloses in its claim 1 a process for preparing alkane sulfonic acid by continuously feeding a thio-compound and chlorine to a reaction zone containing aqueous hydrochloric acid at a temperature of from 85°C to 115°C. The vigorous evolution of hydrogen chloride gas with concomitant turbulence brings the reactants into intimate contact. Thereafter the gas and alkane sulfonic acid are separately withdrawn. The turbulent reaction zone is free of mechanical agitation means (page 1, line 20).



For these reasons, the Board considers, in agreement with the Appellant, the Respondent and the Opposition Division, that the disclosure of document (4) specified above represents the closest state of the art, and, hence, the starting point in the assessment of inventive step.

- 4.3 The drawbacks of this prior art process lie in producing undesirable large amounts of oxidizable impurities requiring further treatment of the crude alkane sulfonic acid to reduce the oxidizable impurities to an acceptable level (patent specification column 3, line 55 to column 4, line 1). Thus, the technical problem underlying the patent in suit, as submitted by the Appellant and as indicated in the specification of the patent in suit at column 3, lines 45 to 48 consists in reducing the amount of oxidizable impurities in the alkane sulfonic acid.

The Respondent formulated the problem underlying the patent in suit differently, namely as providing an alternative method for the preparation of alkane sulfonic acid using mixing elements, as providing improved mixing or as promoting plug-flow by thoroughly mixing. However, the features of using mixing elements, of improving mixing and of promoting plug-flow by thoroughly mixing already form part of the solution indicated in claim 1 to the technical problem underlying the patent in suit. To incorporate parts of the solution offered by the invention into the definition of the problem is inadmissible. It is the established jurisprudence of the Boards of Appeal that the technical problem addressed by the invention must

be formulated in such a manner that there are no pointers to the solution, otherwise an ex post facto view being taken of inventive activity (see decisions T 99/85, OJ EPO 1987, 413; T 229/85, OJ EPO 1987, 237; T 422/93, OJ EPO 1997, 24). Therefore the Board cannot accept the Respondent's submission so that the problem to be considered is the one formulated by the Appellant.

- 4.4 As the solution to this technical problem of reducing the oxidizable impurities in the alkane sulfonic acid, the patent in suit proposes a process which is characterized by passing the contents of the reaction zone through and in contact with stationary mixing elements to promote plug-flow.
- 4.5 The Respondent never disputed that the claimed process successfully reduces the oxidizable impurities in the alkane sulfonic acid; and the Board is not aware of any reason for challenging this finding. The specification of the patent in suit demonstrates in the examples 1b to 3b and the comparative examples 1a to 3a at columns 7 to 9 the successful reduction of the oxidizable impurities in the alkane sulfonic acid. While the comparative examples containing no internal mixing device and, thus, truly reflecting the process of the closest prior document (4), show an amount of oxidizable impurities of 103 ppm, 51 ppm and 149 ppm, respectively, the examples according to the invention having a stationary mixing element show an amount of only 9 ppm, less than 5 ppm and 66 ppm, respectively. For these reasons, the Board is satisfied that the problem underlying the patent in suit has been successfully solved.

- 4.6 Finally, it remains to be decided whether or not the proposed solution to the problem underlying the patent in suit is obvious in view of the cited state of the art.
- 4.6.1 The closest prior art document (4) teaches a process which is free of mechanical agitation means (page 1, line 20). It does not give any incentive to modify that process by using a mixing element and to reduce thereby the oxidizable impurities. Thus, document (4) on its own does not render obvious the solution proposed by the claimed invention.
- 4.6.2 Though document (5) refers to static mixing elements as such, that document does not address the technical problem underlying the patent in suit of reducing the amount of oxidizable impurities in alkane sulfonic acid (see point 4.3 *supra*). For this simple reason document (5) cannot give any hint on how to solve that technical problem since a skilled person would not take the teaching of that document into consideration when looking for a solution to the problem underlying the invention.

The Respondent's objection of obviousness based on document (5) leaves aside the established jurisprudence of the Boards of Appeal that, when assessing inventive step, the decisive question is not whether the skilled person **could** have arrived at the invention, in the present case by incorporating a static mixing element in the preparation process, but whether he **would** have done so with the reasonable expectation of reducing oxidizable impurities (see for example decision T 2/83,

OJ EPO 1984, 265, point 7 of the reasons). Thus, as is clear from the preceding considerations, the latter condition has not been met since the decisive fact remains that document (5) does not address that objective. Hence, the skilled person would ignore document (5) when aiming at a solution to the problem underlying the patent in suit.

Moreover, document (5) does not address a preparation process of alkane sulfonic acid, but is directed to static mixing elements as substitute for dynamic agitators (cf. page 1, table and paragraph 2, first sentence). However, the preparation process of the closest prior document (4) is operated in the absence of mechanical agitation (page 1, line 20) with the consequence that a dynamic agitator cannot be substituted for in that process. Hence, the skilled person would not combine the teaching of document (5) with that of document (4) and therefore not arrive at the solution proposed by the claimed invention.

- 4.6.3 When objecting to obviousness, the Respondent referred to page 7 of document (5) which teaches that an empty pipe was a poor continuous reactor so that the material in the centre was not fully reacted. By inducing radial mixing static mixing elements provided plug-flow. However, that teaching is to be applied to the polymerization of silicone, polystyrene and nylon or to chemical reactions in laminar flow (page 7, right hand column, last paragraph). Those applications are substantially different and unrelated to a preparation process of alkane sulfonic acid which is operated, moreover, in turbulent flow (cf. document (4), claim 1) with the consequence that the skilled person would not

take that teaching of document (5) into consideration when aiming at a process for preparing alkane sulfonic acid.

Furthermore, the Respondent argued in support of his obviousness objection that document (5) addressed on page 3 the achievement of "high-efficiency mixing" and of "plug-flow" in the reactor by using those static mixing elements. However, neither effect is the problem or part of the problem underlying the invention (cf. point 4.3 *supra*). That submission is, thus, irrelevant for the assessment of inventive step.

The Respondent alleged that the effect of reducing oxidizable impurities was necessarily due to completely reacting and, thus, to thoroughly mixing the components, since the oxidizable impurities were unreacted starting materials and intermediates. However, document (5) is completely silent in respect of such a teaching and the Respondent did not indicate any further prior art or other evidence in support thereof. In the absence of any corroborating evidence the Respondent's argument represents merely an unsubstantiated allegation which is to be disregarded by the Board. It rather appears that the Respondent's view is based on hindsight with the knowledge of the present invention in mind which the Board cannot sanction.

4.6.4 To summarize, in the Board's judgment, none of the documents addressed above renders the claimed invention obvious, either taken alone or in combination.

The Respondent not relying on further prior art in order to support his objection of obviousness, the Board is satisfied that none of the other documents in the proceedings renders the proposed solution obvious.

- 4.7 For these reasons the Board concludes that the subject-matter of claim 1, and by the same token that of dependent claims 2 to 6 and of claims 7 and 8, referring to a particular apparatus for the process of claim 1, involves an inventive step within the meaning of Articles 52(1) and 56 EPC.

## **Order**

### **For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of claims 1 to 8 as submitted on 23 August 2000, figures as granted and a description yet to be adapted.

The Registrar:

The Chairman:

N. Maslin

A. Nuss