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**Datasheet for the decision  
of 11 January 2023**

**Case Number:** T 1779/19 - 3.3.06

**Application Number:** 06755414.7

**Publication Number:** 1891187

**IPC:** C10L10/04, B01D53/68, F22G3/00,  
F23J7/00, F23J15/00

**Language of the proceedings:** EN

**Title of invention:**  
METHOD FOR PREVENTING CHLORINE DEPOSITION ON THE SUPERHEATER  
OF A BOILER

**Patent Proprietor:**  
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Valmet Technologies Oy

**Opponent:**  
Vattenfall AB

**Headword:**  
Chlorine deposition/Kemira/Valmet

**Relevant legal provisions:**  
EPC Art. 100(a), 56

**Keyword:**  
Inventive step - (no)

**Decisions cited:**

T 0012/81, T 0666/89, T 0270/97

**Catchword:**



**Beschwerdekammern**  
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Case Number: T 1779/19 - 3.3.06

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.06**  
**of 11 January 2023**

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**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office posted on 30 April 2019 rejecting the opposition filed against European patent No. 1891187 pursuant to Article 101(2) EPC.**

**Composition of the Board:**

<b>Chairman</b>	J.-M. Schwaller
<b>Members:</b>	S. Arrojo
	C. Brandt

## Summary of Facts and Submissions

- I. An appeal was filed by the opponent contesting **the decision of the opposition division to reject the opposition against European patent No. 1 891 187**, claim 1 thereof reading:

*"1. Method for preventing chlorine deposition on the superheater of a boiler in which a fuel with a chlorine content is burned, and to which boiler a compound with a sulphate content is fed in the superheater area, which compound forms a particular reagent to fix alkali compounds, characterized in that the said compound is ferric(III) sulphate,  $Fe_2(SO_4)_3$  and/or aluminium(III) sulphate,  $Al_2(SO_4)_3$ , and the said compound is sprayed on the front side of the superheater as a water solution and in a drop size of 1-100  $\mu m$ ."*

- II. In its statement of grounds of appeal, the appellant requested to set aside the decision and to revoke the patent in its entirety, arguing - on the basis of documents **D7** (Spraying Systems Co, "*Dysor och Armatur För Vätskespridning*" (1995)), **D20** (Roppo J., "*Statement of ferric sulphate operational experiences in UPM Caledonian paper mill HYBEX boiler (BFB) and theoretical background of the performance*" (2015)) and **D22** (Declaration of M. Aho under 37 CFR 1.132) that the invention was insufficiently disclosed, industrially inapplicable and not inventive in view of **D5** (WO 2002/059526) as closest prior art in the light of **D6** (McQuarrie, D. A. & Rock, P.A. *Oxidation-Reduction Reactions. General Chemistry* (3<sup>rd</sup> Ed), W. H. Freeman and Co. (1984)), **D10** ([https://en.wikipedia.org/wiki/Iron\(II\)\\_sulphate](https://en.wikipedia.org/wiki/Iron(II)_sulphate)) or **D35** (Test Report "*Oxidation of*

*Ferrous Sulphate aqueous solution*") and combined with **D4** (JP 11166187 (references correspond to the English translation of this document) or **D8** (Truex et al, "*The thermal decomposition of aluminium sulphate*", *Thermochimica Acta*, Vol. 19(3), 1977) (for the use of aluminium sulphate as additive). It also quoted documents D2, D12, D14, D33, D37, D40 and D41 for the drop size of 1 to 100 µm and requested to admit D11, D13, D17 and D18 into the proceedings.

- III. In its reply, the proprietor and respondent requested to dismiss the appeal and to maintain the patent as granted. Further it requested not to admit documents D2, D12, D14, D35, D37, D40 and D41 into the proceedings.
- IV. In its preliminary opinion, the Board indicated that none of the grounds of opposition appeared to prejudice the maintenance of the patent as granted.
- V. With letter dated 9 January 2023, the proprietor filed a new experimental report designated D44.
- VI. At the oral proceedings, which took place on 11 January 2023, the proprietor requested not to admit D44 into the appeal proceedings. At the closure of the debate the parties declared maintaining their original requests, namely:

The opponent-appellant requested that the patent be revoked in its entirety.

The proprietor-respondent requested that the appeal be dismissed.

## Reasons for the Decision

### 1. Main request - Inventive step

The Board has concluded that the opposition ground under Article 100(a) EPC in relation to Article 56 EPC prejudices the maintenance of the patent as granted for the following reasons:

#### 1.1 Closest prior art

1.1.1 Document D5 discloses (page 1, lines 22-24; page 7, line 37-page 8, line 5; page 8, lines 15-26; claim 1) a method to prevent chlorine-induced corrosion by injecting an aqueous solution of an additive selected from the group of  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)\text{HSO}_4$ ,  $\text{FeSO}_4$  (i.e. ferrous sulphate) and  $\text{H}_2\text{SO}_4$  in the combustion zone and on the front side of a superheater (ref. 5 in figure 1). There is agreement among the parties that this document represents the closest prior art, because it relates to the same technical field and addresses the same problem as the patent in suit.

1.1.2 The appellant argued that following the principles set out in T 666/89, the definition in D5 of a step of feeding a solution of ferrous sulphate in D5 implicitly encompassed feeding a solution of ferric sulphate, because Fe(III) spontaneously reacted in contact with air to give Fe(II), so that at least a portion of the ferrous sulphate would be in the form of ferric sulphate. This was supported by documents D6 and D10, which disclosed this spontaneous reaction. Additionally, according to the test report D35, when Fe(II) was combined with sulfuric acid, as proposed on page 8, lines 10-32 of D5, a major portion of the iron

was oxidised to Fe(III), so also for this reason document D5 implicitly disclosed the use of ferric sulphate. Consequently, the subject-matter of claim 1 differed from D5 only in that the size of the drops was between 1 and 100 microns.

- 1.1.3 The Board does not agree with the above argumentation, first of all, because decision T 666/89 is based on T 12/81, which concluded (Reasons 8) that when a prior art document discloses a chemical reaction, a substance necessarily obtained using the conditions described therein should also be regarded as implicitly disclosed. As further stressed in decision T 270/97 (Reasons 3.4, last paragraph), the key requirement for such an implicit disclosure is inevitability, implying that it is not sufficient for a reaction to be probable or likely. In other words, to implicitly anticipate a given product, the prior art document must disclose a reaction carried out under specific conditions which would inevitably lead to the product in question.

As pointed out at the oral proceedings, the Board does not contest that ferrous sulphate is oxidised to ferric sulphate in the presence of air. There is however no basis to conclude how far this reaction will go in D5, which does not disclose a reaction but a solution of ferrous sulphate, and there is no information in D5 how this solution is made (i.e. pH, temperature or other components) and how long and under which conditions it should be stored. The presence of ferric sulphate is thus highly likely or even certain, but there is no way to conclude that this presence will go beyond trace levels.

As the appellant admitted at the oral proceedings, the subject-matter of claim 1 cannot be considered to



encompass the feeding of solutions with trace or ppm concentrations of ferric sulphate. This can also be deduced from the fact that claim 1 at issue requires that the "*compound*" (i.e. the ferric sulphate) "*forms a particular reagent to fix alkali compounds*". While this expression does not clearly define a minimum concentration of ferric sulphate in the solution, it implies that its concentration should be high enough to effectively form a reagent (i.e.  $\text{SO}_3$ ) to fix the alkali compounds.

Thus, the assumption that at least some ferric sulphate will necessarily be formed in D5 cannot be extrapolated to conclude that this document anticipates feeding an aqueous solution of ferric sulphate as defined in claim 1.

- 1.1.4 The Board therefore concludes that the subject-matter of claim 1 at issue differs from document D5 in that:
- i) ferric sulphate and/or aluminium sulphate is used as additive; and
  - ii) the drop size is between 1 and 100  $\mu\text{m}$ .
- 1.2 Problem solved according to the patent
- 1.2.1 According to par. [0010] of the patent, the invention is intended to provide an improved method for preventing chlorine deposition in superheaters.
- 1.2.2 To support this improvement, the patent discloses (par. [0021] and figure 1) a comparison of the results obtained with ammonium sulphate ("Reference reagent"), aluminium sulphate ("Corr 1") and ferric sulphate ("Corr 2"). The patent also discloses (paras. [0022] and [0023]) a comparison of chlorine deposition at different sampling points and for several S/Cl (Sulfur

to Chlorine) ratios between known sulfur-containing compounds (figure 2) and aluminium sulphate (figure 3).

1.3 Reformulation of the technical problem

1.3.1 The appellant argued that there was no evidence on file that the claimed additives were more effective than the ferrous sulphate proposed in document D5. Consequently, the only problem solved by the invention was that of proposing an alternative method.

1.3.2 The Board agrees with the appellant in that there is no evidence that the invention provides an improved effectiveness when compared to a method of preventing chlorine deposition using a ferrous sulphate solution as disclosed in D5. The proposed solution does therefore not successfully solve the problem presented in par. [0010] of the patent.

1.3.3 However, the Board considers that the experiments in the patent at least demonstrate that the claimed method perform significantly better than other known alternatives. This implies that the claimed additives have been identified as particularly effective for the purpose of preventing chlorine deposition, so they cannot be considered to be arbitrarily selected.

1.3.4 Thus, the Board concludes that the claimed subject-matter does not simply provide a (general or arbitrary) alternative, but rather an alternative which is highly effective when compared to other commonly used additives. The problem to be solved is therefore reformulated as the provision of an alternative method which ensures a high effectiveness in the prevention of chlorine deposition.

1.4 Obviousness of the solution

1.4.1 The appellant argued that the invention was obvious in view of the combined teachings of D5 and D4, because the latter proposed ferric sulphate as a particularly effective additive to form SO<sub>3</sub> and document D5 provided hints to use droplet sizes falling within the claimed range.

*Obviousness of supplying ferric sulphate as additive*

1.4.2 Document D4 discloses (par. [0001], [0019]) a municipal waste combustion method and proposes the addition of sulfur-containing substances to prevent formation of highly toxic dioxins. The preferred compounds for generating SO<sub>3</sub> are listed in par. [0044] and include inter alia "Fe<sub>2</sub>(SO<sub>4</sub>)" [sic].

The board notes that D4 does not relate to the prevention of chlorine deposition in a superheater, but the chemical mechanisms triggered by the additives are analogous to those presented on page 5 of D5 (see reactions (2) and (3)). In particular, the additives are intended to produce SO<sub>3</sub> to react with chlorine at temperature ranges similar to those in D5, so the board is of the opinion that a skilled person would consider the additives proposed in D4 when looking for effective additives to prevent chlorine deposition in the method of D5.

1.4.3 In the appealed decision, the opposition division concluded (see lines 1 to 3 on page 16) that the formula "Fe<sub>2</sub>(SO<sub>4</sub>)" in D4 corresponded to ferrous sulphate and not to ferric sulphate. This conclusion was based on the absence of the subscript 3 in the sulphate group and on the assumption that the "2" in

the above formula (which is not typeset as a subscript but appears in normal font size) corresponded to the oxidation state of the iron.

While the appellant indicated (see page 23 of the grounds of appeal) that par [0044] of D4 disclosed ferric sulphate, it did not expressly point out that the opposition division had erroneously interpreted the information in this passage, nor did it acknowledge that the formula of the ferric sulphate was incomplete and why this erroneous formula corresponded to ferric sulphate. Thus, in arriving at its preliminary opinion, the Board followed the interpretation presented by the opposition division, which ultimately led to the conclusion that D4 did not disclose ferric sulphate as an additive to obtain  $\text{SO}_3$  and that, consequently, the invention was not obvious in light of the combined disclosures of D5 and D4.

At the oral proceeding this question was addressed in more detail, and the appellant presented the original Japanese text translated in D4, in which the number "2" of the formula clearly appeared as a subscript, which contradicted the interpretation of the "2" as the oxidation state of the iron. Additionally, the appellant argued that it was clear that the absence of the subscript "3" in the sulphate group of the formula " $\text{Fe}_2(\text{SO}_4)$ " was an error, because if this formula were intended to represent ferrous sulphate (i.e.  $\text{FeSO}_4$ ), it would not have been necessary to put the sulphate group in parentheses. Moreover, the iron sulphate in par. [0044] was written next to the temperature  $480^\circ\text{C}$ , which corresponded to the melting temperature of ferric sulphate, in order to explain why this substance was capable of generating  $\text{SO}_x$  at the relevant temperature range of  $350^\circ\text{C}$  to  $700^\circ\text{C}$ . In view of these explanations,

the Board has concluded that the formula " $\text{Fe}_2(\text{SO}_4)$ " in par. [0044] of D4 can only refer to ferric sulphate.

1.4.4 While the proprietor did not contest that D4 disclosed the use of ferric sulphate as an additive, it argued that there would be no reason to select this particular substance among the different alternatives proposed in D4 to produce  $\text{SO}_3$  for preventing chlorine deposition in the method of D5.

1.4.5 The Board disagrees therewith as D4, specifically paras [0049] and [0050], clearly indicates that sulphates are preferred for their lack of corrosiveness and that iron compounds are particularly effective in the production of  $\text{SO}_3$ . In view of these teachings, it is apparent to the board that D4 presents ferric sulphate as a preferred and effective alternative for generating  $\text{SO}_3$ .

1.4.6 The Board thus concludes that a skilled person seeking to solve the underlying problem of finding alternatives which are highly effective in preventing chlorine deposition would consult D4, and that in doing so it would consider using ferric sulphate as an additive in the method of document D5 without the need of inventive skills.

*Obviousness of using a droplet size of 1 to 100  $\mu\text{m}$*

1.4.7 The only remaining question is whether the defined droplet size of 1 to 100  $\mu\text{m}$  represents an obvious alternative for the skilled person.

1.4.8 In this respect, the appellant argued that document D5 referred to the use of atomising nozzles (page 20, line 13) and nozzles forming plumes (page 19, line 8), and that the droplet sizes were controlled using a

compressed air source (page 19, lines 20-24), which represented a clear indication that small sized droplets were desired. Furthermore, D5 indicated (page 22, point "2)") that the injection of additives forming SO<sub>3</sub> was advantageous for preventing poisoning of SCR catalysts. A number of documents relating to SCR (see for example D2, col. 4, line 63; col. 8, lines 61-65 and table 1) indicated that the droplet sizes used for this purpose fell within the range defined in claim 1. Moreover, the patent itself indicated (par. [0026]) that the proposed droplet sizes were easily obtained with commercial nozzles such as the ones used in SCR/SNCR techniques. In any case, the defined droplet size range had not been associated with any specific technical effect and the feature "drop size" had to be interpreted broadly because there was no indication in the claim or in the patent as to how it should be interpreted (as a mean size, a median size or as a size distribution?).

- 1.4.9 The proprietor argued that there was no hint in the prior art to work within this droplet size range and that the inventors had invested a long time in investigating the process and had surprisingly discovered that using small droplets improved the effectiveness of the chlorine deposition process. The reference in D5 to an "atomizing nozzle" concerned a configuration in which the nozzles were not sprayed on the superheater, so it was not relevant. The argument concerning the SCR was unrelated to the prevention of chlorine deposition, so it could only be relied upon with the benefit of hindsight.
- 1.4.10 Having been questioned by the board on the meaning of the term "drop size", the respondent stated that it should be interpreted as an average value, implying

that the range of from 1 to 100  $\mu\text{m}$  represented the mean value of the size distribution.

- 1.4.11 The Board notes that, since the patent does not indicate how the feature "*a drop size of 1-100  $\mu\text{m}$* " should be interpreted, all technically reasonable alternatives should be considered to be covered by the claim. The interpretation proposed by the proprietor is also rather broad, as it encompasses all possible droplet size distributions having a mean droplet size from 1 to 100  $\mu\text{m}$ , which would only exclude sprays with significantly coarse droplet sizes.

The appellant is also right in that the patent does not associate the droplet size with any specific technical effect, and in that the examples of the patent do not even specify the droplet size in the tests, so this feature can only be considered as providing an alternative.

In view of the above considerations, the Board concludes that the relevant question to assess the inventiveness of this feature is whether a skilled person starting from D5 would have considered spraying non-coarse droplets as an obvious alternative.

- 1.4.12 It is not contested that document D5 discloses the spraying of the additives using nozzles (see for example page 8, lines 33-34 and page 15, lines 36-39) as well as means for controlling the droplet size (page 19, lines 20-24). The explicit teaching in D5 to spray the additives to prevent SCR poisoning (page 22, lines 1-5) is a first indication that the nozzles might be those conventionally used in SCR applications. As argued by the appellant and confirmed in par. [0026] of

the patent itself, such nozzles are normally configured to form droplet sizes falling within the claimed range.

- 1.4.13 This teaching is not unrelated to the prevention of chlorine deposition as the proprietor argued, because it is presented as part of a preferred embodiment of D5 in which the additives play a double role in preventing both chlorine deposition and SCR catalyst poisoning.

Moreover, while the proprietor is right in that the reference to an atomising nozzle on page 20, line 13 of D5 concerns an embodiment in which the spray is not discharged in front of the superheater but inside a separate chamber (figures 3 and 4), this is done in order to pre-evaporate the liquid and form small particles of the ammonium sulphate additive that are then distributed in front of the superheater (see page 20, lines 17-21). This is coherent with the fact that in D5 the sulphate is ultimately intended to be used as a (solid) catalyst to form  $\text{SO}_3$  (see reactions on page 5, lines 1-25). A skilled person starting from D5 would therefore have an incentive to adjust the nozzles to obtain small droplets, so that the liquid is rapidly evaporated to form small particle sizes (smaller particles being advantageous, as this increases the catalytic surface).

In view of the above teachings in D5, a skilled person would readily understand that coarse droplet sizes should be avoided and that the nozzles used in the relevant embodiment of figures 1 and 2 should be configured to form relatively small droplets.

- 1.4.14 The Board thus concludes that it would be obvious for the skilled person in view of the teachings in D5 to select nozzles and operating conditions in such way



that small droplet sizes are formed, and that in doing so it would arrive at the droplet size range defined in claim 1 without exercising inventive skill.

1.5 It follows from the above considerations that the subject matter of claim 1 as granted is obvious and therefore not inventive in view of D5 combined with the teachings of D4, and so does not meet the criteria set out in Article 56 EPC.

2. In view of the above conclusion there is no need to address the additional objections under Article 100(b) EPC and 100(a) EPC in relation to Article 57 EPC. Furthermore, since the content of documents D2, D11-D14, D17, D18, D35, D37, D40, D41 and D44 is not relevant to the underlying decision, there is no need to address the question of their admittance.

**Order**

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

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:



A. Pinna

J.-M. Schwaller

Decision electronically authenticated