

Method for Producing Cryolite from Fluorine-Containing Wastewater

Background of the Invention

1. Field of the Invention

The present invention relates to a method for producing cryolite (i.e., sodium aluminum fluoride) from fluorine-containing wastewater. In particular, the present invention relates to a method for producing powder cryolite from fluorine-containing wastewater discharged from factories manufacturing integrated circuits.

2. Description of the Related Art

The wastewater discharged from factories manufacturing integrated circuits contains acidic wastewater, basic wastewater, and fluorine-containing wastewater, wherein the acidic wastewater and the basic wastewater can be discharged after acid-base neutralization. The most commonly method for treating the fluorine-containing waste water is chemical precipitation in which calcium hydroxide is added into fluorine-containing wastewater to release calcium ion, which, in turn, reacts with the fluorine ion in the wastewater to thereby form calcium fluoride that cannot dissolve in water, thereby removing the fluorine ion in the wastewater. However, the solubility and the dissolving rate of the calcium hydroxide are relatively low while the calcium fluoride is generated rapidly such that the calcium fluoride precipitate envelops the surfaces of the calcium hydroxide particles, which stops further dissolution of the calcium hydroxide particles; namely, the calcium hydroxide particles cannot be effectively used. The sludge generated after treatment contains an excessive amount of calcium hydroxide, but the purity of calcium fluoride is low. The sludge has no value in reuse accordingly.

A fluidized bed crystallizing technique has been proposed to convert fluorine-containing wastewater into fluorite, wherein a sensitive instrument is utilized to detect the concentration of fluorine ion in the waste water and control the flow of the wastewater. The amount of water solution of calcium hydroxide to be added into the wastewater is then determined. Under the condition of a particular temperature range and particular crystal species (silicon sand), the

1 fluorine ion in the wastewater reacts with the calcium hydroxide and thus forms calcium
2 fluoride on the surfaces of the crystal species. Thus, the fluorine ion in the wastewater can be
3 converted into useful substances. The fluorine ion in the wastewater can be converted into
4 cryolite by this fluidized bed crystallizing technology if the additive is replaced with
5 aluminum sulfate and sodium chloride. However, the equipment required for the fluidized bed
6 crystallizing technology is extremely expensive and requires professional operators. In
7 addition, the purity of the product is low, as it contains silicone sand, which results in trouble
8 in reuse.

9 Other objects, advantages, and novel features of the invention will become more
10 apparent from the following detailed description when taken in conjunction with the
11 accompanying drawings.

12 Summary of the Invention

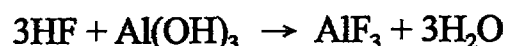
13 An object of the present invention is to provide a method for producing cryolite (i.e.,
14 sodium aluminum fluoride) from fluorine-containing wastewater, wherein aluminum
15 hydroxide and sodium hydroxide are used as the processing agent for treating wastewater to
16 form cryolite precipitate. No expensive equipment or complicated operation is required. The
17 amount of fluorine in the wastewater can be reduced by no less than 80%.

18 The method for producing cryolite from fluorine-containing wastewater in accordance
19 with the present invention comprises adding aluminum hydroxide and sodium hydroxide into
20 the fluorine-containing wastewater to form sodium aluminum fluoride after reaction between
21 the fluorine ion and the aluminum ion as well as the sodium ion. After precipitation, the
22 sodium aluminum fluoride is then dehydrated and dried to obtain cryolite with high purity.

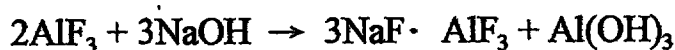
Detailed Description of the Preferred Embodiment

1. Principle:

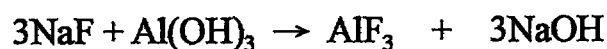
- a. Converting the hydrogen fluoride in the wastewater into aluminum fluoride by aluminum hydroxide:



- b. Converting the aluminum fluoride in the wastewater into sodium aluminum fluoride by sodium hydroxide:



- c. A portion of fluoride in the wastewater exists in the form of sodium fluoride which can be converted into aluminum fluoride after reacting with aluminum hydroxide. The aluminum fluoride then reacts with the sodium hydroxide to form sodium aluminum fluoride:



When the fluorine in the wastewater exists in the form of hydrogen fluoride, for per 60kg of hydrogen fluoride, aluminum hydroxide of 78 kg and sodium hydroxide of 60 kg are added into the wastewater to convert the hydrogen fluoride into sodium aluminum fluoride.

When the fluorine in the wastewater exists in the form of sodium fluoride, for per 126kg of sodium fluoride, aluminum hydroxide of 78 kg are added into the wastewater to convert the sodium fluoride into sodium aluminum fluoride. No sodium hydroxide is required.

The reactive temperature is 0~85 °C. Crystallized cryolite can be formed if the wastewater stays in the reactive trough for 20 minutes or longer. It was found that at least 80% of fluorine ion in the wastewater can be recycled after treatment.

2. Proceeding process or steps:

Aluminum hydroxide and sodium hydroxide are added into the fluorine-containing wastewater to form sodium aluminum fluoride after reaction between the fluorine ion and the aluminum ion as well as the sodium ion. The sodium aluminum fluoride is precipitated and

1 then dehydrated and dried to obtain powder cryolite with high purity. The drying procedure
2 can be proceed at about 100°C.

3 3. Advantages:

4 The aluminum hydroxide dissolves in water; namely, the resultant product (cryolite) has
5 a high purity and is thus valuable in reuse. The resultant sludge in the conventional
6 precipitation method has no reuse value due to low concentration of calcium hydroxide in the
7 sludge resulting from poor solubility of the calcium hydroxide. The fluorine-containing
8 wastewater can be treated without using expensive fluidized bed crystallization equipment. In
9 addition, by means of using the method in accordance with the present invention, useful
10 cryolite can be produced without modifying current equipment of the wastewater-handling
11 factories.

12 Although the invention has been explained with the example of fluorine-containing
13 wastewater discharged from factories manufacturing integrated circuits, it is noted that the
14 method in accordance with the present invention can be used to treat fluorine-containing
15 wastewater discharged from other sources or factories.

16 Although the invention has been explained in relation to its preferred embodiment, it is
17 to be understood that many other possible modifications and variations can be made without
18 departing from the scope of the invention as hereinafter claimed.

What is claimed is:

1. A method for producing cryolite from fluorine-containing waste water, comprising the steps of:
 - adding aluminum hydroxide and sodium hydroxide into the fluorine-containing wastewater to form sodium aluminum fluoride after reaction between the fluorine ion and the aluminum ion as well as the sodium ion; and
 - dehydrating and drying the sodium aluminum fluoride after it is precipitated.
2. The method as claimed in claim 1, wherein the fluorine-containing wastewater is discharged from a factory manufacturing integrated circuits.

