Conference Paper

Improvement of Seawater Salt Quality by Hydroextraction Method

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Abstract

Indonesia is one of the salt producing countries that use sea water as a source of raw materials, the quality of salt produced is influenced by the quality of sea water. The resulting average salt quality contains 85-90% NaCl. Those salt quality are still below of the Indonesian National Standard (SNI) for human salt’s consumption sodium chloride content is 94.7% (dry base) and for industrial salt 98.5%. The improvement of seawater salt quality can be done by several methods: leaching (hydro-extraction), re-crystallization without chemicals or with chemicals, and ion exchangers. In this study we studied the improvement the quality of seawater salt by hydro-extraction method. The objective of this research to improve the quality of seawater salt by hydro-extraction method. The hydro-extraction is a method to improve the quality of salt by washing with saturated salt solution, this method influence by size of salt (diameter), time of hydro-extraction, saturated salt solution concentration and recycle time of saturated salt solution. Based on the results of the research, the hydro-extraction method can produce salt with purity 99.34% NaCl. The condition is achieved at 30/40 mesh salt size and the time of use of saturated salt solution 5 times.

Keywords: Hydro-extraction, improvement, quality, seawater salt,

INTRODUCTION

Indonesia is one of the salt producing countries that use sea water as a source of raw materials, Generally the salt production process through various stages of the process is the first evaporation process, the second evaporation process, the concentration process and the crystallization process. In salt production process, besides producing salt also produced the liquid remaining crystallization called bittern. The quality of the salt produced is influenced by the quality of seawater, process and technology applied. The salt produced in Indonesia has quality average contains 85-90% NaCl. Those salt quality are still below of the Indonesian National Standard (SNI) for human salt’s consumption sodium chloride content is 94.7% (dry base) and industrial salt 98.5%. Based on the quality of the resulting salt and the salt requirements for human salt’s consumption and the industrial salt, a process is required for the salt produced to occupy the requirements. There are several methods for improving the quality of salt included physical and chemical methods, physical method is a method for improving the quality of salt without addition of chemicals such as hydro-extraction and evaporation (re-crystallization) methods and chemical method is added chemicals such as sodium carbonate (Na2CO3), sodium hydroxide (NaOH), barium chloride (BaCl2), calcium hydroxide (Ca(OH)2), calcium chloride (CaCl2) and other (Ihsan, 2002). The hydro-extraction process is an extraction process or a

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separation of a component which is in a solid phase by a liquid phase as a solvent. In this case, the salt is the solid phase and the salt solution as the solvent. The performance of the hydro-extraction process is influenced by the size of the salt, the concentration of the salt solution as a solvent and extraction time (Geetman, 2000).

The re-crystallization process is a process of salt quality improvement through re-crystallization, in this case the salt is dissolved with water and crystallized. The performance of the re-crystallization process is affected by the temperature, and the re-crystallization time, and the re-crystallization stages (Sedivy, 2009; Jhala, 2006; Langer and Offermann, 1988). Application of hydro-extraction method on improving the quality of salt can eliminate insoluble materials such as dust, soil and sand also soluble materials such as magnesium (Mg), calcium (Ca) and sulfate (SO₄), but difficult for material inner of salt because salt diameter too large, the hydro-extraction process more effective if the size of salt very small but not dissolved, size of salt in the market about 30 -50 mesh (Myers and Bonython, 2007). The re-crystallization process can eliminate soluble materials such as magnesium, sulfate, calcium and other because crystal formation and leaving little liquid containing sulfate ions such as magnesium sulfate, this is because magnesium sulfate is difficult to form crystals (Rathnayaka et al., 2013). The Standard for consumption and industrial salt are presented in the following table 1.

Table 1. Standard for consumption and industrial salt

| No | Parameters | Concentration (%) |
|----|------------|------------------|
|    |            | Consumption salt | Industrial salt |
| 1  | NaCl       | min 94.7         | min 98.5        |
| 2  | SO₄        | -                | max 0.2         |
| 3  | Mg         | -                | max 0.06        |
| 4  | Ca         | -                | max 0.1         |
| 5  | H₂O        | max 7            | max 3           |

METHODS

There are 2 (two) types of seawater salt that used in this research as raw research material namely the salt A, and B, with difference qualities. The hydro-extraction process, salt is crusher until, 5, 10, 20 and 30 mesh, extracted by saturated salt solution (360 g salt/liter), salt and saturated salt solution ratio is 1 : 3 (w/w) and mixing for 15 minutes. The salt is separated by filtration, drying and analyzed the content of sodium chloride (NaCl), magnesium (Mg), calcium (Ca) and sulfate (SO₄). Sulfate is analyzed by gravimetric method, calcium and magnesium are analyzed by titrimetry and sodium chloride by stoichiometry. The Improving quality of seawater salt by hydro-extraction methods is presented in the following figure 1.
RESULT AND DISCUSSION

The chemical composition of seawater solar salt that used in this research as raw research material are presented in the following table 2.

Table 2. Chemical composition of seawater salt

| Types of Salts | NaCl   | Mg    | SO₄   | Ca    |
|---------------|--------|-------|-------|-------|
| Salt A        | 92,24% | 0,036 | 0,465 | 0,220 |
| Salt B        | 89,86% | 0,35  | 0,890 | 0,210 |

Table 2 shows that the seawater salt product that used as a study has a quality below the standard for consumption and industry salt. Sodium chloride (NaCl) content lower than consumption and industrial standard, sulfate (SO₄), magnesium (Mg) and calcium contents are higher than industrial standard.

The Effect of Salt Size on the Quality of Seawater Salt Product

The objective hydroextraction method is to extract (remove) sulfate (SO₄), magnesium (Mg) and calcium contents of salt by saturated salt solution. The salt size effect on the quality of seawater salt for hydroextraction method are presented in the following figure 1, 2 dan 3.

Figure 2 shows that salt size affects the NaCl content of salt, for salt type A can produce salt quality could be enhanced up to consumption and industrial standard for 20 and 30 mesh salt size, but for salt type B can produce salt quality could be enhanced up to consumption standard only. For salt type A has sodium chloride content 99.26 -99.46 %.

Figure 2. The salt size effect on NaCl content of the salt
Figure 3 shows that salt size affects the sulfate (SO$_4$), magnesium (Mg), and calcium (Ca) content of salt product, for salt type A can produce salt quality could be enhanced up to consumption and industrial standard for 20 and 30 mesh salt size. Sulfate content 0.12%, magnesium (Mg) 0.01% and calcium 0.07%.

Figure 4 shows that salt size affects the sulfate (SO$_4$), magnesium (Mg), and calcium (Ca) content of salt product, for salt type B can produce salt quality could be enhanced up to consumption only because sulfate content 0.31%, magnesium (Mg) 0.09% and calcium content 0.10% that are higher than industrial salt standard.
CONCLUSION

Based on the data of research results obtained from this study can be concluded several things including:

1. The quality of seawater salt as research materials has different quality, the two seawater salt samples has concentration 92.24 % for salt type A and 89.86 % for salt type B of sodium chloride content, including size and color.

2. The hydro-extraction method for salt type A can produce salt with the purity of sodium chloride could be enhanced up to 99.26 % for size salt 20 mesh and 99.53 % for 30 mesh and sulfate content 0.12%, magnesium (Mg) 0.01% and calcium 0.07%. Base on NaCl and impurities content, salt product from salt type A can be used as consumption and industry salt.

3. The hydro-extraction method for salt type B can produce salt with the purity of sodium chloride could be enhanced up to 96.64 % for size salt 20 mesh and 97.53 for 30 mesh and sulfate content 0.31%, magnesium (Mg) 0.09% and calcium content 0.10%. Base on NaCl and impurities content, salt product from salt type B can be used as consumption salt only.

4. Industrial salt can produced by seawater salt that has sodium chloride content more than 90%.

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