

The manufacturing process of zinc acetate dehydrate with low energy consumption and environmental pollution

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ABSTRACT

This manufacturing process is intended to produce less energy consumption and less environmental pollution of pure zinc acetate dehydrate with zinc oxide and acetic acid. Experimental results in this manufacturing process showed that high purity zinc acetate dehydrate could be prepared.

Keywords: Zinc acetate dehydrate, Manufacturing process, Energy, Environmental pollution, Food additive, Medicine raw material

INTRODUCTION

Zinc acetate has long been used as antiseptic, mordant, hemostatic and astringent. Recently, zinc acetate dehydrate has been used to make a variety of nano zinc oxide [1~3] products and catalysts [4, 5]. Zinc is used to make food additives and medicines, etc. [6, 7] Here, the first generation of zinc products is in the form of inorganic salts such as zinc sulphate, the second generation of zinc products is in the form of organic salts such as zinc acetate, and the third generation of zinc products is in the form of glucose zinc, protein zinc, zinc yeast, etc. [8, 9]

Three are known ways to make zinc acetate. First of all, it is a method of preparing basic zinc acetate (LBZA) that forms a layer from a reaction solution containing zinc compound, acetic acid and basic compounds (hydroxyalkyl amine). [10, 11] Next, it is the method [12] of preparing zinc acetate anhydride by heating high temperature in the presence of a catalyst (hydrogen peroxide) with zinc oxide, glacial acid and water as raw materials, and by filtration, enrichment, crystallization, and dehydration. It is also a method [13] of evaporating the solution obtained by dissolving zinc oxide or zinc hydroxide powder in an aqueous solution of acetic acid to a supersaturated state, cooled to 0~5°C for 15~20h, then precipitated acetate to dry at 35~45°C degrees to make zinc acetate dehydrate. The mass ratio is zinc oxide or zinc hydroxide : water : acetic acid = 1:(1.6~2.0):(1.8~2.2).

This proposal will discuss the process of making zinc acetate dehydrate, which is well soluble in water and is not toxic and available as a food additive and pharmaceutical raw material, cheaper in a simpler process, less expensive, less energy consumption and less environmental pollution.

Manufacturing method and manufacturing process of zinc acetate dehydrate

The chemical reaction equation that reacts zinc oxide with acetic acid to produce zinc acetate dehydrate is as follows.



This reaction is a thermodynamic spontaneous process, which can also take place under normal temperature and pressure conditions.

In order to increase the yield of zinc acetate dehydrate and reduce the production cost and impurities, zinc oxide and glacial acetic acid with ZnO content greater than 99% are selected as raw materials. Zinc oxide, used as a raw material, reacts well with acid and has a content of material not dissolved in hydrochloric acid of less than 0.1%, a arsenic content of less than 0.001%, and a white fine powder free of residue and mechanical scams.

Theoretically, the solubility of zinc acetate dehydrate is 40g/water 100ml(25°C), so the water required to dissolve zinc acetate dehydrate 1g is 2.5ml and the water required to make zinc acetate dehydrate 1g is 0.15ml. Therefore, the water required to make and dissolve zinc acetate dehydrate 1.827g. at 25°C is 4.84ml. As this time, the concentration of acetic acid solution is 16.8%. Experimental results for the reaction properties of zinc oxide and acetic acid under 25°C, 0.1Mpa conditions are shown in table 1. Experimentally, as shown in table 1, from the concentration of acetic acid solution above 20%, the reaction products are not liquid, but gel, or mixture of crystalline, fine powder and liquid, making it difficult to filter and to ensure purity. In addition, if the concentration of acetic acid solution is too low, the amount of solution to be evaporated to dry is greater. Thus, in the reaction with zinc oxide and acetic acid, the optimal concentration of acetic acid solution is set to 10~15%.

Under 25°C, 0.1Mpa conditions, the reaction vessel is stirred by adding zinc oxide to the reaction vessel, adding water to the optimum concentration of the acetic acid solution, strring and adding glacial acetic acid. The reaction vessel is sealed and allowed to stand, then filtered to discard the residue. The filtrate is placed in a stainless steel container and heated to concentrate until the volume is about 0.4~0.6 times the initial volume. In general, the addition of crystal seed to the supersaturated solution promotes crystal growth rate.[14] Providing the crystal seeds needed to change the formation of homogeneous phase nucleation into an anomalous nucleation process will result in a faster crystal growth rate and a smaller crystal size, resulting in an increase in crystal density and uniformity. In our concentrate, a small amount of zinc acetate dehydrate crystal powder is added to the crystal seed and crystallized as it cools to room temperature to make a highly purified zinc acetate dehydrate crystal and separate. Since zinc acetate dehydrate is dehydrated at 50-90°C[15], the separated zinc acetate dehydrate crystals are dried at 35~45°C, crushed and screened to make zinc acetate dehydrate powder and then packed in a container. zinc acetate dehydrate crystals are separated and the remaining solution is involved in a synthesis or enrichment process. In addition, the vapour containing some acetic acid from the concentration, drying process, is condensed and returned to the acetic acid reaction, preventing acetic acid from going out into the atmosphere.

Table 1. Reaction properties with zinc oxide and acetic acid undue 25°C, 0.1Mpa conditions

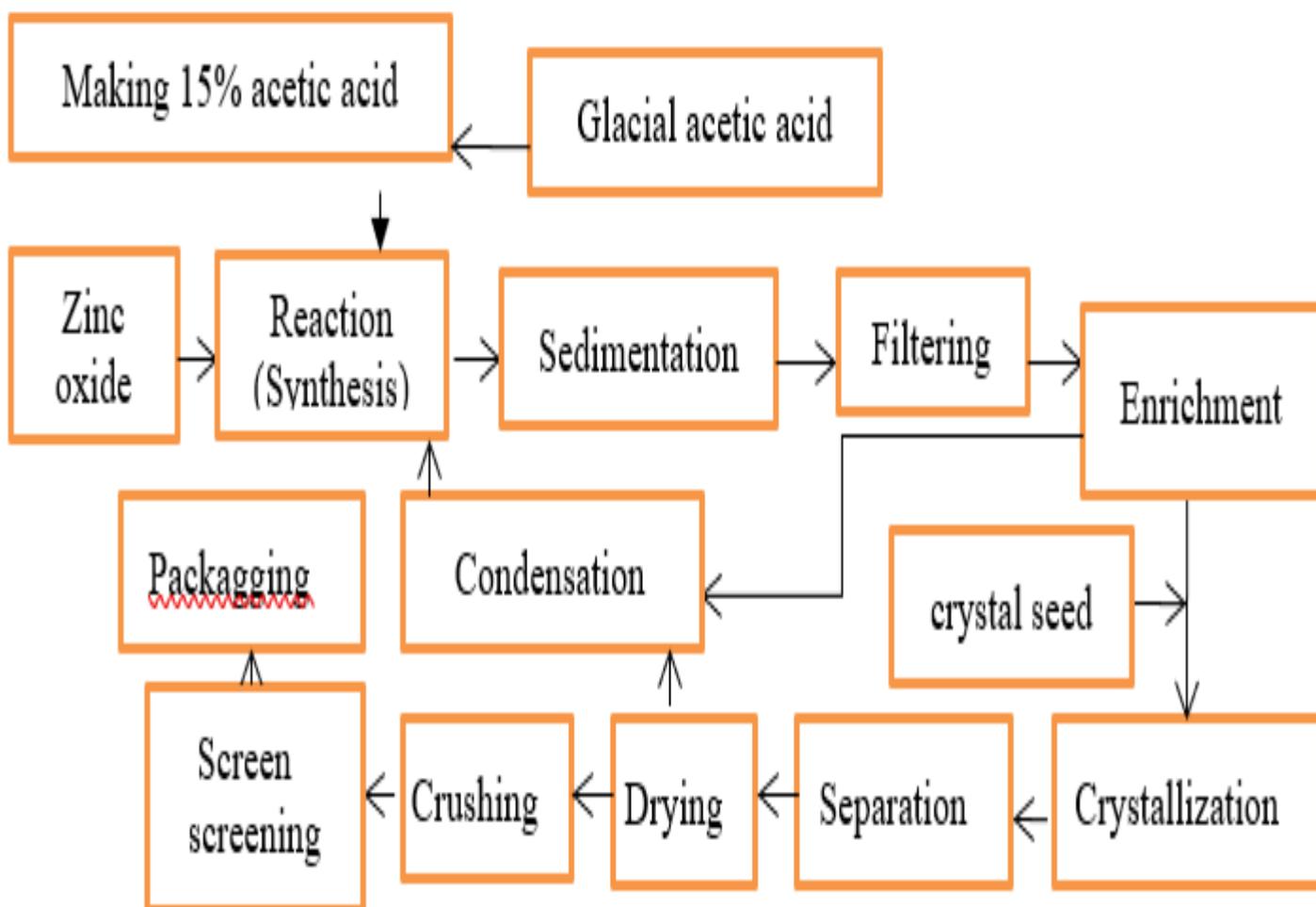
Acetic acid solution concentration, %	Acetic acid solution volume, ml	Zinc oxide mass, g	Mass of residue, g	Characteristics of the residue	Zinc acetate yield rate, %
30	49.2	10	6.94	Crystalline and fine powder	-
25	59.04	10	2.22	Crystalline and fine powder	-

20	73.8	10	1.38	Crystalline and fine powder	-
15	98.4	10	0.32	Fine powder	96.8
14	105.43	10	0.31	Fine powder	96.9
13	113.54	10	0.3	Fine powder	97
12	123	10	0.29	Fine powder	97.1
11	134.18	10	0.28	Fine powder	97.2
10	147.6	10	0.26	Fine powder	97.4
5	295.2	10	0.19	Fine powder	98.1

The manufacturing process chart of zinc acetate dehydrate powder is shown in figure 1.

X-ray diffraction analysis of the samples obtained by reaction of zinc oxide With acetic acid through the same manufacturing method and manufacturing process as above confirmed that the chemical fomula was a crystal of $Zn(CH_3COO)_2 \cdot 2H_2O$, i. e., almost pure zinc acetate dehydrate crystal.(figure 2.)

Figure 1. Manufacturing process chart of zinc acetate dehydrate powder



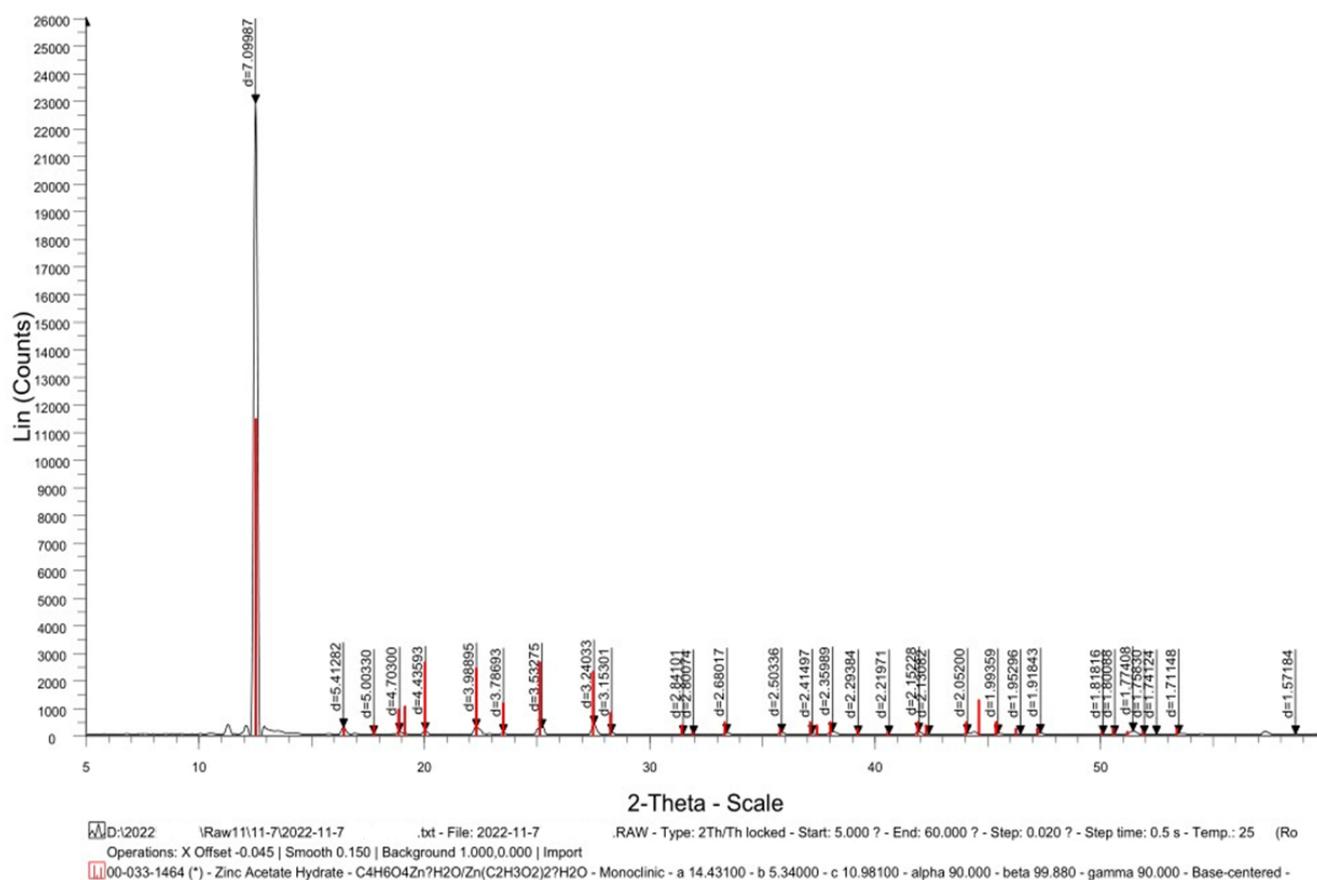


Figure 2. X-ray diffraction graphics for the sample

(Analyzer D8 ADVANCE, Measurement voltage 40KV, Measurement currents 40mA, Scan intervals 0.02°/0.5s)

Zinc acetate dehydrate powder obtained from crushing this crystal is a white crystalline powder with a slight bitter, astringent flavor. The zinc content (average of 10 cases) of zinc acetate dehydrate powder, as measured by complexon titration, is 29.77%, which is considered to be of high purity.

CONCLUSIONS

The proposed manufacturing method and manufacturing process of zinc acetate dehydrate makes it possible to obtain products with low energy consumption and environmental pollution and high purity.

The results of this study were received in the patent of the DPR of Korea.

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