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Preparation of Water based Magnetic Fluid with the Spent Iron Oxide Catalyst

Huiping Shao*[1], Hyo Sook Lee[2], Eun Hee Kim[2]and Chong Oh Kim[1]

[1]Department of Materials Engineering, Chungnam National University, Daejon, South Korea

[2]Korea Institute of Geoscience & Mineral Resources, Daejon, South Korea

1. INTRODUCTION

The water-based magnetic fluid was prepared with a spent iron oxide catalyst containing about 75% magnetite and about 25% else mine by mechanochemical method. The spent iron oxide catalyst has been thrown from the styrene monomer production company and filled in the landfill. The spent catalyst wastes have become an environmental problem and it has presented an opportunity for a new business to rejuvenate, recycle and convert the spent catalyst to an environmentally acceptable safe material [1]. According to the contents of catalyst, the catalyst is very profitable to prepare magnetic fluid. Magnetic fluid is stable colloidal suspensions composed of single-domain magnetic nanoparticles dispersed in appropriate solvents [2]. In this study, not only good magnetic fluid was prepared with the spent iron catalyst for the first time, but also the spent iron catalyst was recycled in an effective way to reduce environmental pollution.

2. EXPERIMENT

To prepare the magnetic fluid by mechanochemical method, an attritor was adopted. First, the different ball diameter, the different weight ratio of ball: sample: water was investigated by experiment. The particle size was analyzed by Particle Size Analyst (PSA). Second, under the different temperature, the particles were coated with different surfactants and at various times. A difficulty associated with the preparation of magnetic fluids is that the particles have large surface area-to volume ratios and thus tend to aggregate to reduce their surface energy [3]. So to do experiment with appropriate surfactant is very important to disperse the magnetic particles well. The prepared magnetic fluid was charactered by Transmission Electron Microscopy (TEM), Vibrate Sample Magnetometer (VSM) and X-ray Powder Diffraction (XRD).

3. RESULTS AND DISCUSSION

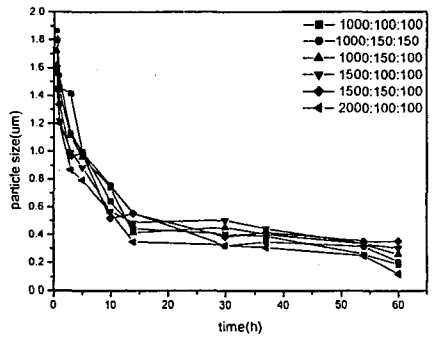

Fig 1

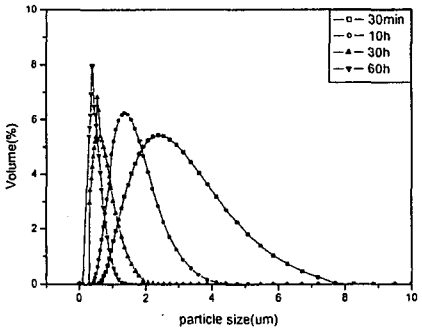

Fig2

At the beginning of experiment, the different ball diameter was done. In this experiment, 5mm ball was an optimum. Fig1 shows that under the same ball diameter, particle size changes following with time by changing the weight ratios of ball, sample and water. From figure, we see that the particle size decreases with increasing the grinding time, and the ratio of 2000:100:100 is the optimum condition. Fig2 shows that under the different grinding time, the particle size volume percent changed with particle size. Fig3 shows that under the same ratio, the character of magnetite was analyzed by X-ray diffraction under the different grinding time. The decrease of X-ray peak intensities with increasing milling time correlates with the increased structural disorder caused by the ballistic nature of the milling processes [4]. Fig4 shows that the TEM micrograph of the magnetic fluids

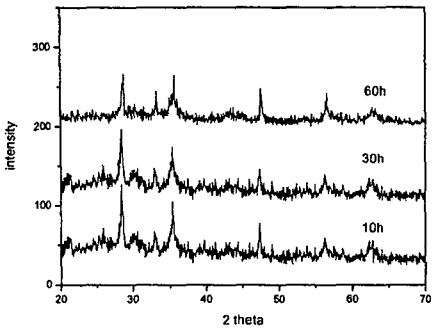

Fig 3

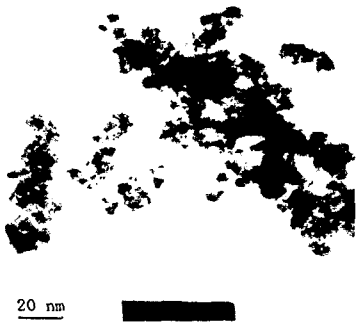

Fig 4

particles. The size of the particles is about 10 nm by TEM. Fig 5 shows the effect of the different surfactants on magnetization of magnetic fluid. Oleic acid is a kind of unsaturated fatty acid, it contains hydrophile bond, and the water-based magnetic fluid is stable using it than else saturated fatty acid. To saturated fatty acid, the carbon link is longer; the magnetization of magnetic fluid is lower. So Oleic acid is one of good surfactants.

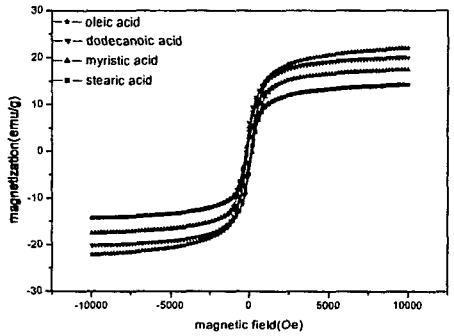

Fig 5

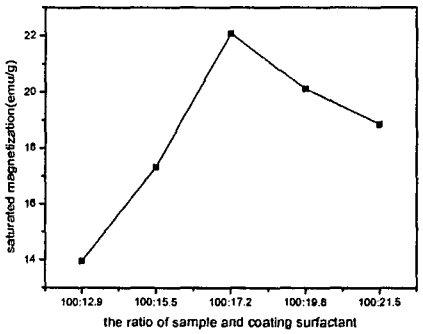

Fig 6

The amount of coating surfactant has important effect on magnetization. In case of the fewer amount, the fluid subsists residual electric charge, and can be agglomerated, the solution is not fluid; if the amount is more, the magnetization of magnetic fluid has affected due to the residual surfactant. Under the same else experiment conditions, after adding different amount of surfactant, the saturated magnetization shows in Fig6. When the ratio of sample and surfactant is 100:17, the saturated magnetization was attained the largest value.

4. CONCLUSION

It is the first time to prepare water based magnetic fluid with the spent iron oxide catalyst by mechanochemical method. The saturated magnetization of water based magnetic fluid was obtained 22.09emu/g. The optimum mechanochemical conditions are the weight ratio of ball: sample: water as 2000:100:100 at 80°C; 60 hours, and the best surfactant is Oleic acid. The spent catalyst was reused to make into useful magnetic fluid, and it would contribute to reduce the environmental pollution.

5. REFERENCE

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