Sediment Studies of Magnetic Dispersions

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Abstract

Magnetic suspensions are widely at fabrication of magnetic fluids, which are concentrated resistant dispersing systems. Magnetic suspensions underlie in fabrication of toners for copying engineering, magnetic tapes for record of information. The quality of terminal products largely depends on the dispersion ability of magnetic. It is more reasonable produce highly dispersive magnetic, using a condensation method of synthesizing.

It is shown that the degree of dispersion of produced magnetic by a condensation method depends substantially on pH of enviroment. The presence of a excessive acid results in magnification of the dispersion degree and accordingly in a stability improvement of a disperse system. This also allows to obtain a product with pregiven dispersion degree, which is extremely important for improvement of the quality of magnetic fluids. It is shown, that the concentration of suspension on an extent of aggregation of magnetic fragments

The conducted investigation allow to plan the dispersity of the terminal product.

Introduction

The highly dispersive ferromagnetics are widely utilizing in research work. One of the most important features of finely divided materials, determining their physicochemical and processing properties, is their granulometric composition.

Quality of made toner considerably depends on dispersion ability of magnetic slurry. In most cases magnetic dispersion is received by a mechanical dispersion. However, it does not give a possibility to gain magnetite of a high scale of dispersion ability. It is expedient to gain highly dispersive magnetite by a condensation method. Besides inflecting conditions of synthesizing, the possibility is afforded to influence on degree of dispersion.

We studied aggregate stability of samples of magnetite obtained by a condensation method.[1] Sedimentation analysis is frequently applied to control the dispersity of powders in both industry and science.

The theory of sedimentation analysis is based on the regularities of the motion of a spherical solid particle in a medium of constant viscosity and density under the effect of gravitational force and was generalized in Refs. 2 and 3. The application of this theory to the determination of the granulometric composition of various disperse systems and methodological approaches to the sedimentation analysis of specific systems were described in Ref. 4. Avdeev[5] studied the functions of the particle size distribution and their applicability to the description of the granulometric composition of polydisperse systems. When determining the dispersity of suspensions, it is necessary to exclude the effect of particles on one another when estimating their individual dimensions. In the case of finely dispersed suspensions, the coagulation of particles during sedimentation analysis may result in some inaccuracy. In the study performed in Ref. 6 the conditions of sedimentation analysis under which coagulation processes may be neglected were formulated.

There are some principles of sedimentation analysis. To the first group we account the methods, in which this analysis is conducted with separation of a disperse phase into separate factions. It can originate in quiet fluid, and also in flowing stream of fluid. The methods included into the second group, are methods, in which there is no immediate separation of a disperse system on a factions: the method of analysis by gravimetric is referred to them. In this case a sediment curve showing dependence of mass of sediment settling from settling time is constructed by results of continuous determination of sediment settling mass. In substantial polydisperse systems the curves of subsidence have a smoothly varying course. Sedimentation analysis is carried out on weights of Figurovskii or by torsion-balance technique.[7]

The shallow enough colloidal particles, similarly to molecules, commit calorific random motion and participate in diffusion, and are under the same laws, as molecules in molecular dispersions. The fragments of a disperse phase in coarse-dispersion systems are rather great and do not commit a translational Brownian motion. They are rather rapid precipitated. The more largely fragments of a disperse phase, the faster they precipitate. Therefore it is possible to do particle sorting of polydisperse slurry on factions by the sizes, that is to set its fractional composition.

The sedimentation analysis of aqueous dispersions of models of magnetite was done by a weight method, applying torsion-balance techniques.[7] The sedimentation curves were processed by the piece-wise smooth-approximation method, and a set of dispersity parameters was determined.[8] This method allows to describe kinetics of subsidence of slurry by finite number of rectilinear parts and to gain accounts, known for an analytical method, of the average quantitative characteristics of dispersion ability.

In Figures 1 and 2 the curves of sedimentation of powdered magnetite included in miscellaneous amounts in investigated disperse systems are presented. As one can see from the figure 1 reduction of an amount of a disperse phase results to insignificant magnification of aggregate stability of dispersed slurry. At study of models of magnetite obtained in acidic environment, the reduction of an amount of a disperse phase reducts aggregate stability of investigated slurry. Probably, it is connected with partial peptization and also modification of a disperse phase in more concentrated slurry.

On a base of experimental data the account of most probable radius of fragments obtained models of magnetite is presented. This radius is presented in a Figures 1,2.

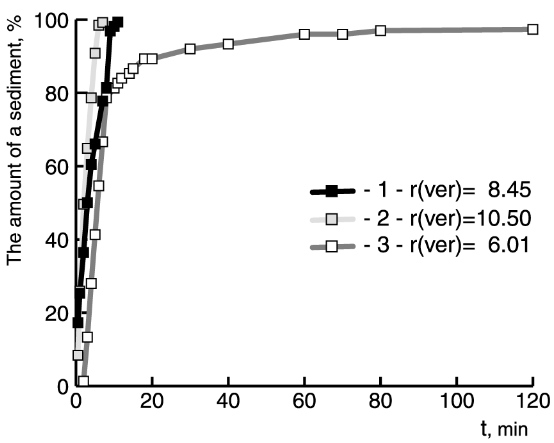

Figure 1. The curves of sedimentation of powdered magnetite. The magnetite synthesizing in water environment. Concentration of a disperse phase compose: 1 - 0.50%, 2 - 0.25%, 3 - 0.13%.

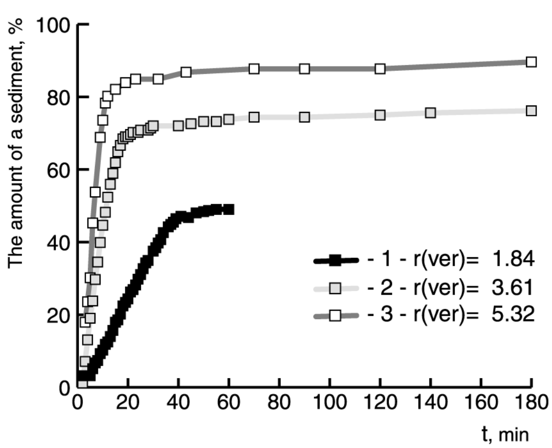

Figure 2. The curves of sedimentation of powdered magnetite. The magnetite synthesizing in acidic environment. Concentration of a disperse phase compose: 1 - 0.50%, 2 - 0.25%, 3 - 0.13%.

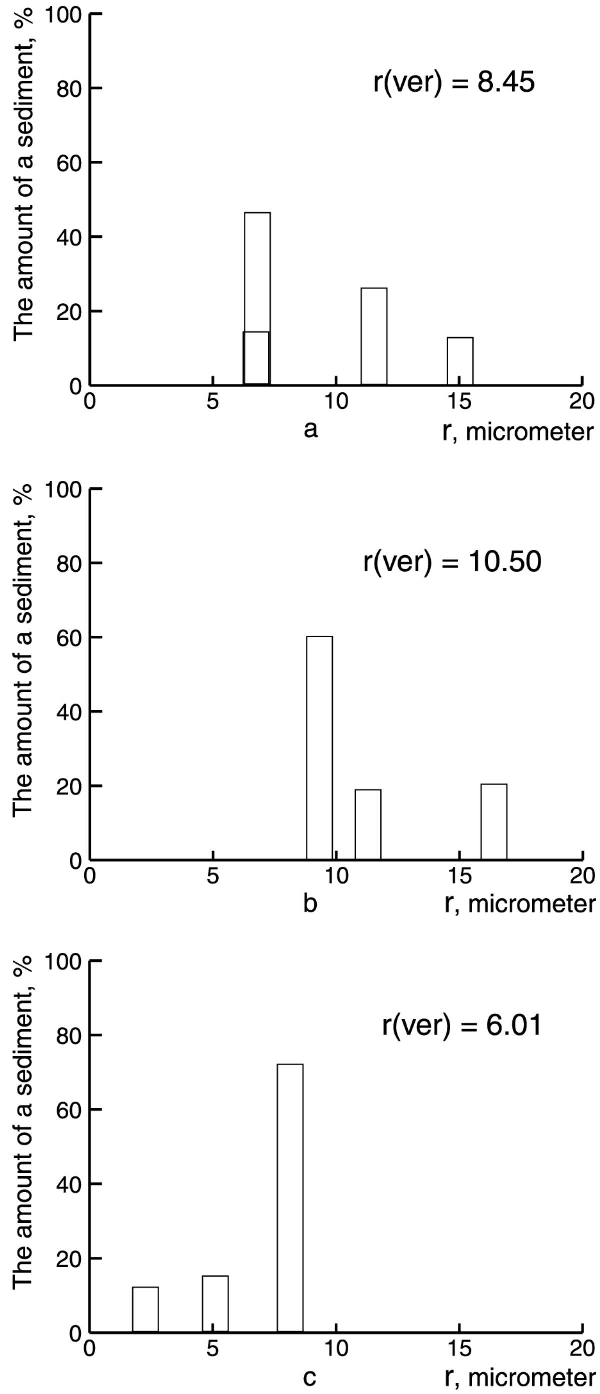

Figure 3. The histograms distribution of particles of magnetite by radius. The magnetite synthesizing in water environment. Concentration of a disperse phase compose: a - 0.50%, b - 0.25%, c - 0.13%.

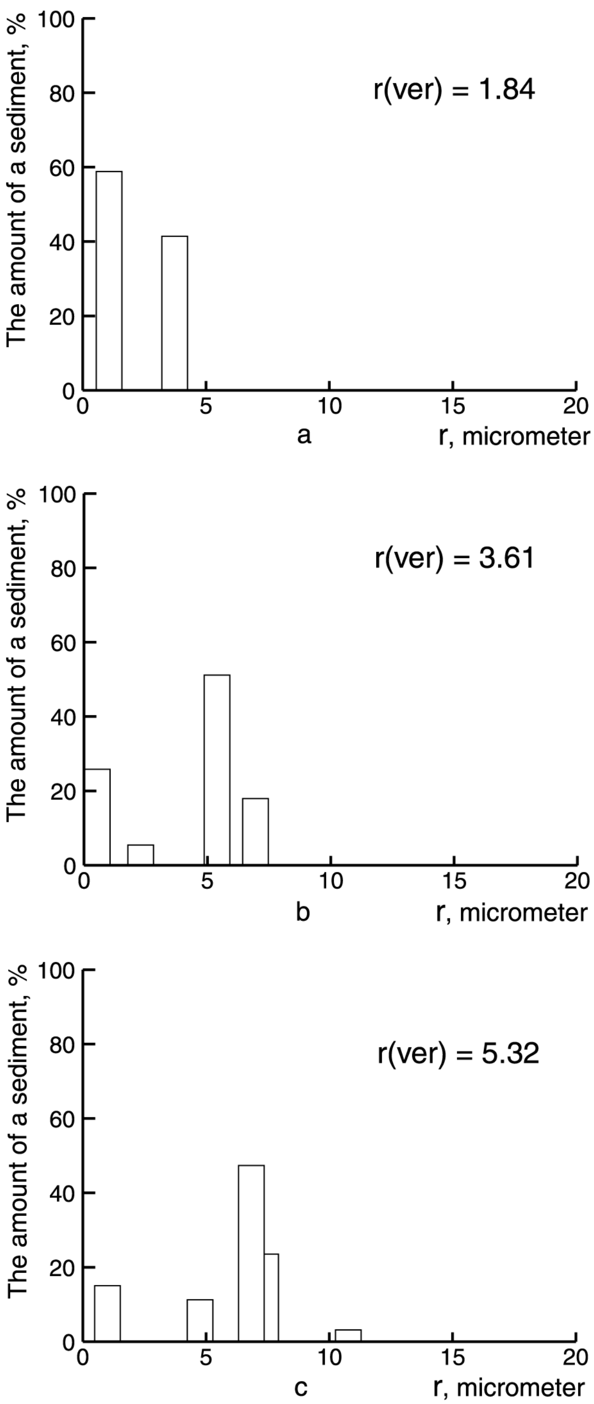

Figure 4. The histograms distribution of particles of magnetite by radius. The magnetite synthesizing in aciding environment. Concentration of a disperse phase compose: a - 0.50%, b - 0.25%, c - 0.13%.

The histograms characterizing fractional composition of obtained slurries are constructed. It is evident from the Figure 3 reduction of an amount of a disperse phase leads to formation of more dispersed slurry. At synthesizing magnetite in acidic environment more highly dispersive particles of magnetite are formed, what is testified by the histograms in the Figure 4.

Conclusion

Influence on aggregate stability of aqueous dispersions of magnetite its quantitative substance in a dispersing medium has been studied by the sedimentation analysis method. It has been shown, reduction of an amount of a disperse phase leads to magnification of aggregate stability of magnetite in an aqueous dispersing medium and reduction. The presence of acidic environment results to formation more highly dispersive slurry.

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Biography

Iryna Opaynych received her M.S. in Physical Chemistry from the University of L'viv in 1965, and her Ph.D. in Chemistry from the University of L'viv in 1983. Dr. Opaynych is current an associate professor of chemistry at the chemical faculty of the L'viv University. She has published over one hundred papers, including inventions, one of inventions has been patented in USA, France, UK, Japan and others countries. Iryna Opaynych works in the area of polymeric composite materials chemistry.