A THEORETICAL STUDY OF THE EFFECT OF INTERPARTICLE INTERACTIONS ON THE MAGNETIC PROPERTIES OF FERROFLUIDS

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Abstract

To begin with we studied the magnetic properties of a ferrofluid neglecting the interparticle interactions between the particles in the fluid. Then we took two kinds of interparticle interactions into account. The first kind results from interaction of atomic magnetic moments. These moments depend basically on the external magnetic field and the internal magnetic field (H') which is called the molecular field (Weiss field). Two cases were considered: One is the dependence of magnetization on the total magnetic field (H_t), the other is dependence of magnetization on the external field (H). The second kind of interaction is the magnetostatic interparticle interaction between the magnetic dipoles. A comparison was then drawn between the magnetic properties with and without interactions particularly in the calculation of the initial susceptibility of the system. It is found that the second kind of interparticle interaction gives a stronger effect on the initial susceptibility $\chi$ than the effect of the first kind on $\chi$. It was found that the initial susceptibility is affected by the distribution of sizes of particles in the fluid. We assumed a Lognormal distribution and compared the result of the calculation with that assuming particles of uniform size. We found that the initial susceptibility is greater in the case of Lognormal distribution than in the case of particles of uniform size.