Improved Understanding on Collection of Airborne Particles By Permanent Magnetic Assembly

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Abstract

Magnetic nanoparticles have diverse applications ranging from contamination control to medical diagnosis and treatment. Small airborne particulate matter (PM) is known to have adverse impacts to human health,, due to its high mobility when penetrating human respiratory systems [1,2,3]. Airborne PM consists of a multitude of chemical components [4,5], many of which are paramagnetic and ferromagnetic. It appears that use of a magnetic field could provide the ability to selectively remove the airborne PM which has magnetic components and effectively separate the particles from the air based on their magnetic property. To optimize the design of a multi-stage magnetic separator, we used the COMSOL multiphysics software to model the magnetic field required for the separation and to investigate particle removal in the separator [6,7]. In the study described here, we performed a precise side-by-side comparison of the computed and measured magnetic fields. The simulated magnetic field flux density, B, was compared to that obtained by the Hall probe scanning measurements on the surface of the magnetic core. The included figure shows the comparison. Note that the COMSOL B values were approximately 23% higher than those measured at the peaks. Other than the three peak values, the overall pattern of the computed B reasonably follows that of the measured value. The differences of the two B curves could be due to several factors including the materials used and geometric description in the model, for instance. The spatial resolution of the Hall Probe could also contribute to the difference, because the probe might average over some small but still finitely wide, distance that represents a little averaging. The area under the Hall probe plot seems to be comparable to the area under the COMSOL plot that might be discretized finer for the model predictions than for the Hall probe measurements.

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Figures used in the abstract

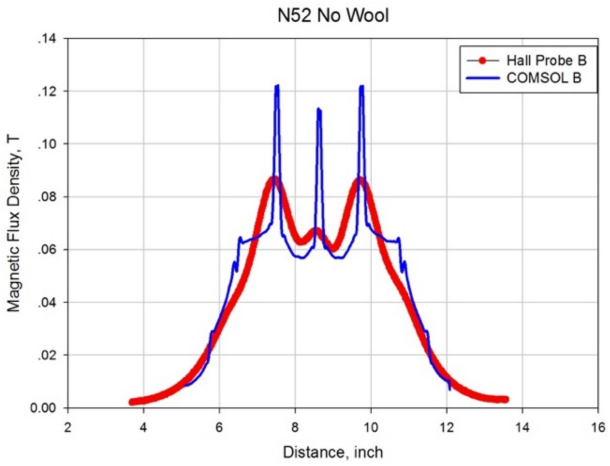

Figure 1: Comparison of magnetic flux density vs. hall probe measurement.