The Frantz® Magnetic Barrier Laboratory Separator Model LB-1

Additional Information

Figure 1.: A mixture of diamagnetic and weakly paramagnetic grains undergoes separation in the field of the Magnetic Barrier Laboratory Separator (Model LB-1). The magnetic system is inclined so that gravity urges particles toward the far side of the chute and down its length. The light-colored diamagnetic grains are deflected along the magnetic barrier, while the darker paramagnetic grains pass through it and out of the fields in the channel on the far side of the divider.

Separation in the Barrier Field

The stream of particles traveling through the field of the Magnetic Barrier Laboratory separator is split by opposed magnetic and nonmagnetic forces. Magnetic force transverses to field direction and deflects particles of selected susceptibility from the paths in which gravity urges them. The process is continuous.

The paths of all material undergoing separation, including the most strongly magnetic components, are parallel to the midplane between the opposed faces of the pole pieces, perpendicular to the flux path. Near the midplane, where the stream of material undergoes separation, the force attracting particles toward the pole pieces is negligible, no matter how strongly they are magnetized.

Magnetic energy gradient (HdH/dx) in the separating region of the Barrier field has a pattern that may be likened to a packet of thin sheets, with their surfaces aligned with the lengthwise axis of the gap between the pole pieces. Along the length of each sheet magnetic energy gradient transverse to field direction is constant. Across the width of the separating region magnetic energy gradient transverse to field direction rises from sheet to sheet, from low values at the outer fringes of the field to maximum value at a sheet near the center of the separating region.

Material is moved by gravity across the field, through the succession of sheets of ascending magnetic force, toward the region of maximum transverse force. Particles of like susceptibility encounter like magnetic force per unit volume.

Particles having susceptibility such that magnetic force opposing their motion exceeds gravitational force are deflected in the vicinity of the sheet of maximum transverse force, while particles having susceptibility that is weaker or of opposite sign pass through it. A component of gravity urges both fractions toward a mechanical divider and out of the field.

Conventional separators employ magnetic force aligned with field direction to attract particles toward magnetized collecting surfaces. Magnetic force has maximum value at such a surface and decreases rapidly with distance from the surface. The force experienced by any particle in conventional separators depends on the accident of its position in the field. Particles passing close to a surface may be captured, while particles passing farther away may escape.

The Barrier technology, by providing conditions in which particles of like susceptibility encounter like magnetic force per unit volume, has inherent advantages in selectivity and sensitivity for separating materials according to slight differences in susceptibility.1

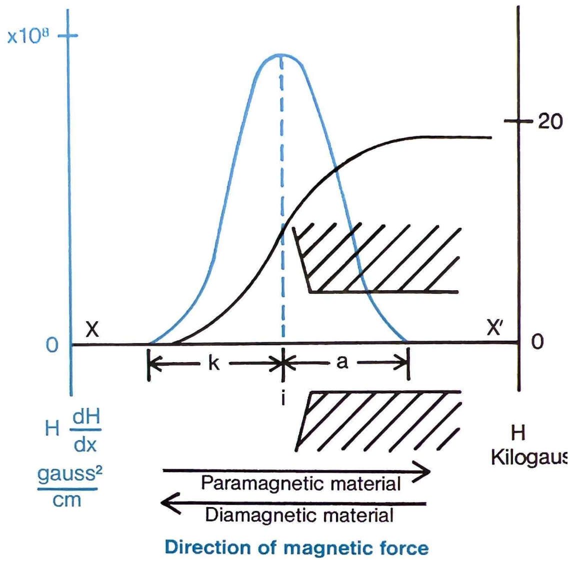

Figure 2. Superimposed graphs of magnetic field intensity, H, and magnetic energy gradient, HdH/dx, at the midplane x-x, between the opposed pole faces show the characteristics of the barrier field and its location near the outer edge of the gap. The graphs are based on measurements taken at the midplane with a maximum current of about 1.8A supplied to the coils.

In the katadynamic region, k, the energy gradient increases in the direction in which field intensity increases. At the isodynamic plane, i, it reaches a maximum value. In the anadynamic region, a, energy gradient declines in the direction in which field intensity increases, reaching zero value where field intensity is maximum and uniform.

1. U.S. Patent No. 4,235,710, issued Nov. 25, 1980, to Jack J. Sun, assigned to S. G. Frantz Co. Inc., covers means and methods for separating material at a magnetic barrier; the Company holds similar patents in countries which constitute its principal markets.

Figure 3.: Separation by exploiting paramagnetic susceptibility is shown here. The mixture is fed into the anadynamic region inside the gap of the LB-1. The magnetic system is inclined so that gravitational force urges particles toward the near side of the chute. The darker paramagnetic grains can be seen moving along the magnetic barrier, while the light-colored diamagnetic grains pass through it. The sample is the same mixture of diamagnetic and weakly paramagnetic grains used for the separation shown in Figure 1.

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