

HANDOUT 11-1

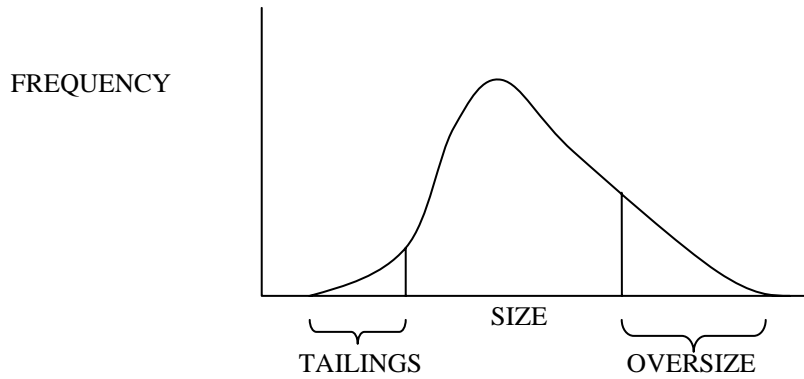


Figure 11-1. Size distribution indicating undesired tailings and oversize particle ranges.

There are many processes that may be used to classify particles:

Screening	These methods are effective, but rate of production may be low.
Sieving	
Air or water classification	These methods take advantage of different drag forces acting on different size particles.
Physical separations <ul style="list-style-type: none"> • Magnetic • Gravity • Electrostatic • Radiation • Color 	These methods rely on physical properties other than differences in fluid drag to classify.

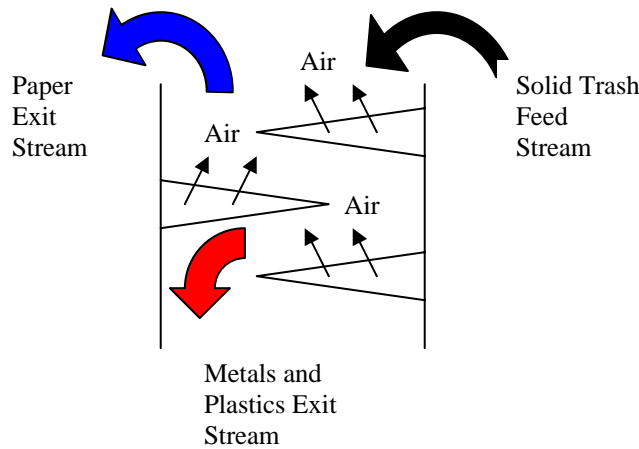


Figure 11-2. Air classifier for separating paper and low density materials from solid waste streams. The large drag force to gravitational force ratio of the air on the low density materials causes materials such as paper to separate from plastics and metals.

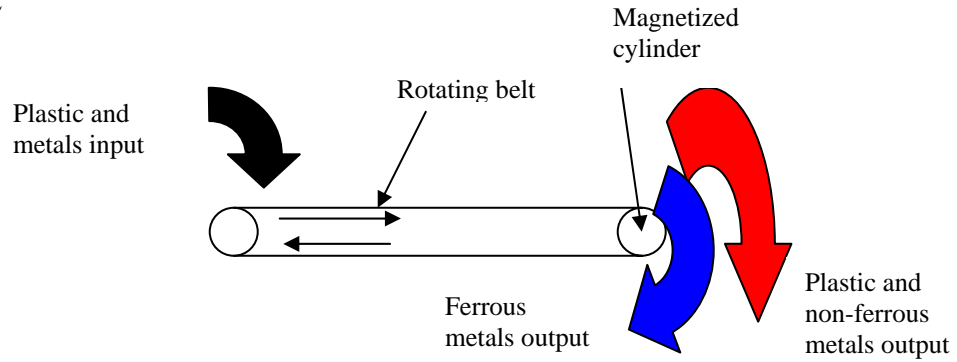


Figure 11-3. Example of a magnetized separator. As the belt rotates around the magnetized cylindrical roller the ferrous materials cling longer to the belt than non-ferrous materials fall off and thus allow separation.

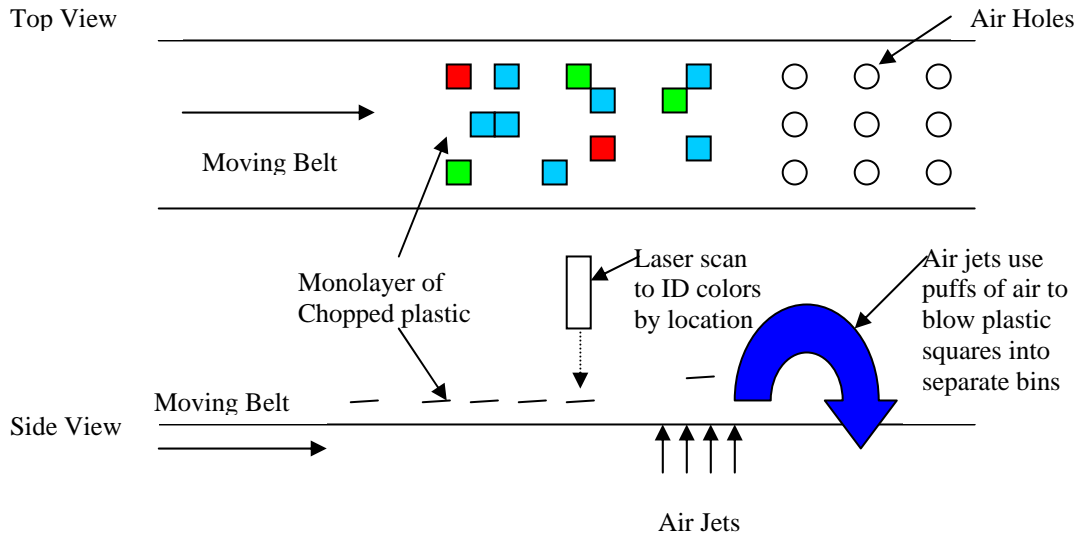


Figure 11-4. Separation by color. Chopped plastic pieces are spread in a monolayer on a perforated moving belt. Lasers scan the belt and identify the locations of plastic pieces of specific colors. Air jets corresponding to the locations of the identified plastic pieces apply puffs of air to blow the plastic pieces into bins.

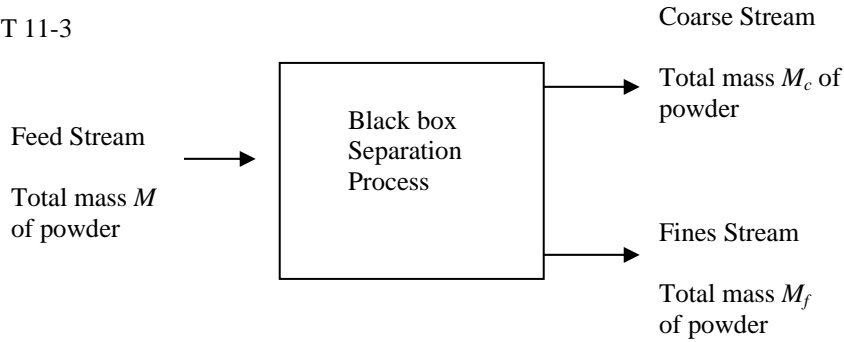


Figure 11-5. Black box (hypothetical) separation process to separation coarse particles from fine particles.

The total mass balance gives $M = M_c + M_f$. (11-1)

The total separation efficiency, E_T , is defined as $E_T = \frac{M_c}{M} = 1 - \frac{M_f}{M}$. (11-2)

Assume that there is no agglomeration or comminution in the separator. For a particle size, x , the masses of size x in each stream are noted by M_x, M_{fx}, M_{cx} . The grade efficiency of separation of size x is defined as

$$G_x = \frac{M_{cx}}{M_x} \quad (11-3)$$

$$\begin{aligned} M_x &= M (\text{fraction of size } x) \\ &= M f_x dx \\ &= M dF_x \end{aligned} \quad (11-4)$$

For the Coarse Stream $M_{cx} = M_c f_{cx} dx = M_c dF_{cx}$ (11-5)

Hence $G(x) = \frac{M_c f_{cx}}{M f_x}$. (11-6)

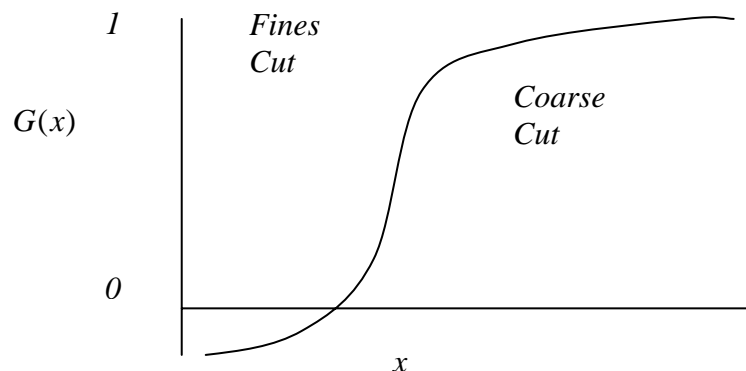


Figure 11-6. Typical S-shaped grade efficiency curve. At a point, x , on the curve, $G(x)$ represents the fraction of particles of size x that are separated out of the feed stream and contained in the fines product stream.

HANDOUT 11-4

A sample of the feed, coarse, and fines streams for a separation of a material "Hexamethyl chicken wire" is screened with the following results:

Screen Size (microns)	Average Particle Size	Feed Size mass Fraction retained on screen ΔF_x	Mass Rate of particles size x in Feed Stream M_x	Coarse Size mass Fraction retained on screen ΔF_{cx}	Mass Rate of particles size x in Coarse Stream M_{cx}	Fines Size mass Fraction retained on screen ΔF_{fx}	Mass Rate of particles size x in Fines Stream M_{fx}	$G(x) = \frac{M_{cx}}{M_x}$
850		~0		~0		~0		
600	725	0.30		0.45		0.075		
425	512.5	0.40		0.45		0.325		
300	362.5	0.20		0.09		0.365		
212	256	0.10		0.01		0.235		
Total		1		1		1		

The stream rates are:

- Feed rate = 100 lbm/hr
- Coarse Product Rate = 60 lbm/hr
- Fines Product Rate = 40 lbm/hr

Plot the grade efficiency curve and calculate $I_{20/80}$.

