

Trial plan – Effect of particle size distribution using an air table

Trial host/location: David Sanderson. Alvan Blanche, Wiltshire

Trial date: 26th March 2009

Duration: 1 day

Attendees: Mike Bennett, Vincent O'Hora

Trial contact: David Sanderson, davidsanderson@alvanblanch.co.uk, 01666 577333/07715 612594

Trial equipment: Destoner - Pressure Type

A Destoner has been chosen to investigate how particle size distribution affects the separation capacity, as it is known to be sensitive to this factor. Initially a gravity separator was chosen for this trial but the decision was made that due to the large number of variables involved, it would hinder the delivery of satisfactory results for the trial.

The Destoner at Alvan Blanch is designed to remove stones/metal accurately and reliably from the feed material. However it is suitable for removing a wide range of unwanted material. Alvan Blanch most commonly use this piece of equipment for the separation of cereals, peas, beans, lentils and coffee beans.

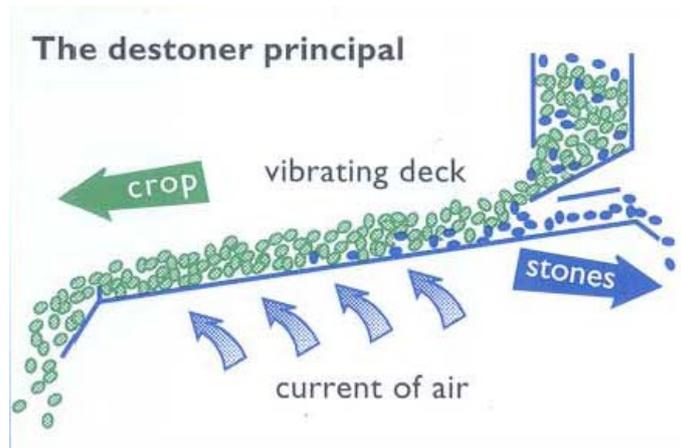
The ability to adjust and lock the settings on the Destoner will ensure the most accurate separation possible. This particular piece of equipment is capable of a throughput of 750 kg/hr to 8 te/hr; however for this trial, capacities of this scale will not be necessary.

A Destoner works in a similar way to an air table. This particular piece of equipment operates by selecting differences in specific weights between the product and the unwanted material. The mixture of material is input through a regulated feed onto a vibrating bed where it is stratified through a combination of the bed vibrations and the pressurized airflow from beneath the bed. Upon stratification the lighter of the two materials will rise to the top, while the heavier particles sink. As the bottom strata is in contact with the bed it experiences an uphill throw, this causes the heavier particles to climb up the deck until they are discharged.

Pressurised airflow is in the opposite direction to the movement of the heavy material and forces the lighter material to float down the bed and be discharged (see figure below). Assuming the settings are correct, no heavy material should be discharged with the lighter material and no lighter material should be moved up the bed with the heavy material.

Settings are simple to adjust and lockable which will ensure consistency in results. It is advised that the input material is pre-graded in order that the correct mesh is used and no material passes through the bed.

Below is a picture of the Destoner to be used on the trial and also a simple depiction of the Destoner basic principle:



Trial objectives:

This objective of the trial is to investigate the effect of particle size distribution on the separation performance of an air table (Destoner). For this trial, Axion's PS04 plastic will be mixed thoroughly with chipboard wood in 90:10 ratios, respectively.

This separation is possible due to the differing density and shape of each type of material- lighter, smaller particles are generally fluidised by the air flow and travel downwards on the separation deck under the force of gravity. Heavier materials are not fluidised and hence are conveyed up the deck in the opposite direction to the light fraction. Particle size distribution is an important factor in obtaining a good separation as larger, less dense materials can often struggle to become fluidised and so tend towards the heavies stream. The opposite is also true i.e small dense materials can become fluidised making them tend to the light fraction.

There is also the effect of particle-particle interaction to consider. With a tighter particle size distribution this phenomenon will have less influence on the separation.

Axion hope to establish a clear correlation between the separation capability and the percentage of fines (0-3mm) present in the feed. The removal of wood is often important during WEEE recycling.

Sample material:

A number of different samples will be tested. All samples will consist of standard Axion plastic known as PS04, and chipboard wood. This wood is to be granulated and mixed into these samples. The plastic to be used has a size range of approximately 0-15mm.

The mixture of the chipboard and PS04 will be sieved into three fractions, 0-3mm, 3-8mm and 8-12mm.

The following matrix of samples will then be tested:

Trial	0-3mm	3-8mm	8-12mm
1	100%	0%	0%
2	0%	100%	0%
3	0%	0%	100%
4	33%	33%	33%
5	0%	50%	50%
6	10%	45%	45%
7	20%	40%	40%
8	30%	35%	35%
9	40%	30%	30%
10	50%	25%	25%

The samples for trial 6-10 will not actually be made up prior to the trial but the material will be taken ready for mixing.

During the testing the final decision will be made about which ratios of each fraction will be used.

Around 100kg in total of material is to be tested for separation, so therefore approximately 33kg of each size range, all of which will contain 10% chipboard wood.

Sample shipping address:

Alvan Blanch
Chelworth,
Malmesbury,
Wiltshire,
SN16 9SG

Trial procedure:

The mixtures for the first five runs will be made up prior to arriving at Alvan Blanch. The samples for the runs 6-10 will be made up on site. From runs 1-5, the product samples will be weighed and analysed. From these results, the efficiency of the separation can then be estimated. Depending on the separation capacity from these first five trials (see table below), a further five trials will be performed with increasing percentages of fines (0-3mm) in each run. The increase in % of fines chosen for the later samples will depend on the results obtained from runs 1-5. If it is observed that the separation capability is dramatically reduced from 0% fines to 33% fines, an incremental increase of 5% will be used as appose to 10%.

All runs, 1-10, will be performed in the exact same manner and under the exact same operating conditions with the primary objective being to create a wood fraction and a plastic fraction.

It is anticipated that as the % of fines present in a sample run increases, the separating capability of the Destoner will decrease and that the ten runs proposed for this trial with produce a definite correlation between the two.

Sampling/results to collect during the trial:

During the trial samples need to be taken of the product materials for the proposed separations as shown in the table below.

Trial	Input	Product 1 Weight and Sample	Product 2 Weight and Sample	System Settings
1				
2				
3				

4				
5				

Any important settings for the machine should be noted during operation along with taking photographs of the equipment and material when possible and relevant.

Post trial analysis of the samples including hand sorting for the plastic mixtures will be conducted at Axion's laboratory in Salford in order to determine if the size distribution of particles has an effect on the success of the separation.

All trial material should be returned to the following address:

Axion Polymers
Langley Road South
Salford
M6 6HQ

Vincent O'Hora, Axion Recycling, February 2009