

Trial Plan - Titech NIR

Trial host/location: Titech, Germany

Trial date: Tuesday 25th November 2008

Duration: 1 day

Attendees: Nicola Myles (Axion), Mike Bennett (Axion), Brian Gist (Titech)

Trial contact: Brian Gist (UK rep), gist@titech.com, Mobile: 07912390539

Trial equipment: The Titech equipment uses a near infrared (NIR) sensor to detect the characteristic infrared spectrum of light reflected by an illuminated object. The NIR spectrum of each material is unique and hence the detector within the machine can identify specific materials. When a material which needs to be removed is detected, air jets are activated at the correct time and location to remove the unwanted material from the main product stream. The equipment for this trial is a new high resolution NIR sensor which has not been used before and will be used in all the trials discussed below.

Trial objectives: There are several specific objectives which will be investigated during the trial:

- a) Investigate the effect of particle size distribution on the efficiency of the sort. The aim of this is to determine and quantify how well the machine performs on different size fractions. Ideally this trial should be kept fairly straight forward to ensure that it is the size distribution which is being assessed and not, for example, material colour. From the results of the trial it should be possible to determine whether screening the material before passing it through the NIR yields a better separation along with the minimum size limit for efficient identification;
- b) Test the limits of darkness of particles before the NIR stops identifying them for a range of different polymer types;
- c) Identification and ejection by polymer type from a mixture. This is to test if a separation such as PS from ABS would be possible. Filled PP may have a detrimental effect on the final polymers physical properties when it is extruded hence being able to remove it would be beneficial. Post separation analysis of the results will be conducted at Axion's lab to assess the success of the separation; and
- d) Identification and ejection of minor impurities which includes nylon, silicone rubber, polycarbonate and PMMA. Trials have previously been performed on Titech's NIR equipment hence there is already an indication of how well the contaminants may be removed from the WEEE. The objective is to now perform similar trials on the new high resolution NIR sorter allowing for a direct comparison to previous trial results.

Sample material: A number of different samples for the trial are required in order to test the various objectives listed above.

The following samples have been chosen:

- a) 3 x 30kg samples (all white material)
 - 1) Sub 6mm 90% PS / 10% PE
 - 2) 6-12mm 90% PS / 10% PE
 - 3) Unscreened 90% PS / 10% PE

Note of how samples (a) were produced:

Firstly white fridge material (PS01) was granulated and sieved at 6mm.

White PE (virgin material) was then granulated. This was then spiked into the PS01 sub 6mm and over 6mm fraction to give a 10% fraction of PE in the samples, (a1) and (a2).

A sample of unscreened PS material was spiked with 10% PE, (a3).

- b) 9 x black sample plaques of PS and PP prepared by Axion's lab - samples were prepared by the addition of 0.5% to 5% black master batch to virgin PS and PP in 0.5% increments.
- c) 250kg of PS11 (for PS/ABS separation after contaminant polymer removal).
- d) 250kg of PS07 (for contaminant polymer removal).

Sample shipping address:

TITECH GMBH

OTTO-HAHN-STRASSE 6

MULHEIM

56218

GERMANY

Trial procedure:

- a) **Size distribution:** To investigate the effect of particle size distribution on the sort efficiency samples with particles at various sizes were required. Specific samples have been made up for this part of the trial as explained above. The intention is to run all three samples (a1, a2, a3) through the NIR machine which has been set up to positively eject the PE from the binary PS/PE mixture.
- b) **Black PP and PS:** The investigation of the limits of detection of black material before the NIR stops identifying the material is a simple test. A range of different polymer plaques have been made up which includes numerous black samples of PS and PP to show the scale of blackness. All of the plaques will be placed in front of the NIR sensor to see if it can detect them. May also discuss when on site with Titech the possibility of running the belt at different speeds with the plaques on to investigate if this has an effect in relation to the level of blackness.

- c) **PS11:** The trial to test the identification and ejection by polymer type relates to sample (c). If time allows the sample will be run through the system to remove contaminants, such as nylon, silicone rubber, polycarbonates, PMMA and filled PP. The material will then be passed through again to separate the ABS and PS. If time is tight the contaminant removal step will be skipped and the PS/ABS separation performed on the sample as it is as this is the priority for this part of the trial. May also consider investigating a colour separation where the machines ejects all colours and not black or white. This is based around the idea all colours are ABS but some ABS is black so the success of this separation is doubtful and is also time dependent.
- d) **PS07:** The final part of the trial will be to identify and eject minor impurities. Sample (d) is PS07 which contains impurities such as nylon, silicone rubber, polycarbonate and PMMA. The sample will be run through the machine with the objective being to remove all of the contaminants.
- e) **PS01:** If time allows a trial will be run on the sample (a) fridge material with the aim being to eject the nylon contaminant. This is a repeat of trial (d) just on a different material.

Sampling/results to collect during the trial:

During the trial numerous samples will be taken for later analysis at Axion in order to determine the success of the NIR technique.

It is proposed that the following samples will need to be collected along with the weights.

Trial	Input Material	Reject Fraction	Accept Fraction	Input Weight	Reject Weight	Accept Weight
a1 (Size Distribution)						
a2 (Size Distribution)						
a3 (Size Distribution)						
B (blackness level)						
c (PS11 PS/ABS separation)						
d (PS07 contaminant removal)						
e (PS01 contaminant removal)						

The samples both input and output will undergo analysis at Axion's lab in order to determine various features of the samples.

The size distribution of samples (a) is known as this material was specifically created for this trial. Analysis will need to be done on the reject and accept fraction to determine the composition of PE and PS in each fraction along with measurement of the size distribution of the product.

For trial (b) the level of blackness of the plaques have to be determined to make the results from the trial meaningful. There are two ways of doing this. Either level of masterbatch added can be used as a guide to the level of blackness or a standard scale of blackness which gives reference points can be used. The second option is preferable and will be used in this case. Rather than having accept and reject samples and weights it is more likely that from this part of the trial the results from the machine, identified or not identified, will simply be correlated to the level of blackness of the samples.

For samples (c) and (d) the composition of the PS11 and PS07 feed material needs to be known. This can be done by using the FTIR machine at Axion's lab. Approximately 400 chips from each sample are required to give a guide to the ABS/PS ratio.

Small samples of the product streams should be taken during the trials with the remainder of the material being returned to:

Axion Polymers,
Langley Road South,
Salford,
Manchester,
M6 6HQ

During the trial photographs of the equipment and samples should be taken for use in the final report. Any important information which may assist with the analysis of the results should also be recorded.

Other information:

Flight information

Date	Operator	Flight Code	Route	Departs	Arrives
Mon 24 Nov 08	Flybe	BE7267	Manchester to Frankfurt	16:00	18:50
Tue 25 Nov 08	Flybe	BE7268	Frankfurt to Manchester	19:30	20:25