

Trial plan - Pallmann, differential impact milling

Trial host/location: Pallman, Germany

Trial date: 20th -21st January 2008

Duration: 1 or 2 days

Attendees: Robin Hilder (Axion), Lidia Goyos-Ball (Axion)

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Trial equipment: Differential Impact Milling

At the Pallmann technical centre there are three mills which would be suitable for the impact milling trial.

The first mill appears to be an involuted pin with coarse pins (in German, Schlagnasenmühlen). There are two models of this version of impact mill. The first, the PXL18, has a capacity to handle approximately 30 kg/hr at <8mm particle size of feed material. The second model, the PX315, has a larger capacity at approximately 300-500 kg/hr at a larger feed particle size of 20-30mm.

The second mill is also an involuted pin mill but with relatively fine pins (in German, Zahnscheibenmühle). This mill has a capacity for approximately 1000 kg/hr of feed at 20-30mm particle size.

The preferred mill at this stage is the PXL18. The process variables of the PXL18 are the feed rate and rotor speed.

Trial objectives: The objective of the trial is to explore the potential to exploit the varying levels of brittleness of different polymers in order to be able to separate polymer mixtures by polymer type.

Two groups of materials will be trialled:

1. Pairs of thermoplastics with different impact properties (polyolefins and styrenics or polyamides and styrenics); and
2. Thermoplastics and elastomers.

Sample material:

A range of sample options are being considered for this trial:

Thermoplastic pairs:

- a) Use virgin polymers to make up moulded samples which can then be milled. It is suggested that to get thermoplastic pairs with the same density range either 20% talc or chalk-filled PP could be used for the polyolefin polymer and Axion's PS02 product from TV recycling for the styrenic polymer.

The preference is to use talc filled PP because it should have a better surface finish and higher impact strength due to the finer particle size. A check has been made with Matweb which lists a grade from Asahi Thermofil that should be available in the UK although other compounders such as Albis should also have such grades. If this

material is taken as natural then there would be an excellent contrast to the black PS02. However although this is a good match on density the notched impact strength is lower than the PS02 whilst the unnotched is roughly similar. It is possible to boost these materials with impact modifiers but there is a huge drop in the impact strength once 10% or more of filler has been added compared to unfilled PP. If the trial was done with unfilled PO and PS there would be a good separation in impact strength but in a system that would sink/swim separate. The behaviour of the filled material within the impact mill is unknown; it may be very different to the Izod impact values.

ABS and PA would also be good candidates since they have a minimum of factor two greater Izod impact strengths and sit right in the same density range as PS. Given the difficulties in separating ABS and PS currently, it would be worthwhile to at least run a couple of runs on the impact mill with this material.

- b) Use hand-dismantled whole WEEE items which Axion is holding at Salford from the recent WRAP kerbside WEEE collection trial. These items have already been separately identified by polymer type by Axion. The polyolefin and styrenic items could be shredded separately and then mixed in a known proportion. Ideally the materials would be sorted by colour prior to shredding in order to make identification of the particles easier after differential milling. For example all polyolefins from orange items, all styrenics from black items.
- c) Use hand-picked mixed small WEEE material from S Norton, Axion's sister company-a major primary WEEE recycler, with the same comments about choosing single colours for each polymer to make subsequent identification simpler.

If the moulded virgin polymer and the hand sorted WEEE from the kerbside collection project work well in the initial trial then amore statistically robust sample of Norton's WEEE could be tested at larger scale.

Thermoplastics and elastomers:

The material used here will be coat hanger trouser clips from one of Axion's suppliers called Braitrim. These are composite items with rubber bonded to polystyrene. Axion supplies the polystyrene for these products so it will be very easy to obtain a sample.

It is likely that around 120-150kg of feed material will be required. The material needs to be moulded and the amount required is likely to be too much to process at Axion's laboratory in Salford. It could however be easily done on a suitable industrial scale machine with a single shaft. Therefore, well in advance of the trial date, the sample material needs to be processed. Either Faust, in Germany, who is believed to injection mould flat plates, could be used otherwise a UK moulder dealing with PS02/PS13 is required.

Sample shipping address:

Pallmann Maschinenfabrik GmbH & Co. KG
Wolfslochstrasse 51
D-66482 Zweibrücken

Trial procedure:

The preferred mill at this stage is the PXL18. If the mill were to operate in 20 minute time slots then 12 sessions should be managed in a day.

Based on the two process variables, feed rate and rotor speed, a matrix of two material blends at 3 speed and 2 feed rates could be completed in a day.

However it would be advisable to plan the trial over two days giving contingency for any problems whilst also allowing time for more experimental runs. Two days will be necessary if both the virgin (Norton's WEEE) is processed along with the filled PP.

Sampling/results to collect during the trial:

Using the above matrix the following samples will need to be collected during the trials:

Material	Feed Rate	Rotor Speed	Input material sample and weight	Output material sample and weight
Blend 1	Rate 1	Speed 1		
Blend 1	Rate 1	Speed 2		
Blend 1	Rate 1	Speed 3		
Blend 1	Rate 2	Speed 1		
Blend 1	Rate 2	Speed 2		
Blend 1	Rate 2	Speed 3		
Blend 2	Rate 1	Speed 1		
Blend 2	Rate 1	Speed 2		
Blend 2	Rate 1	Speed 3		
Blend 2	Rate 2	Speed 1		
Blend 2	Rate 2	Speed 2		
Blend 2	Rate 2	Speed 3		

Once the chosen feed rates and rotor speeds are known this information can be put into the table.

Other information:

The following points on health and safety have been raised:

- All of the equipment is CE approved;

- Sample quantities are relatively small so no handling issues are expected;
- Fine polymers and polymer dust are a potential explosion hazard so we need to obtain guidance notes from Pallmann on how they address this; and
- The precise layout of the technical centre is not known as yet so no assessment can be made of trip and fall hazards, but it is governed by German H&S regulations.

Queries to ask the trial host:

A discussion with Pallmann about the cooling of the equipment and how temperature affects brittleness is required.

Nicola Myles, Axion Recycling, January 2009