Project Consortium

SMEs

CESAP	http://www.cesap.com
COLOREX	http://www.colorex.nl
EXTRICOM	http://www.extricom.de
EXTRUDER EXPERTS	http://www.extruder-experts.com
GENESIS	http://www.genesisps.co.uk
MAPEA	http://www.mapea.com
POLIMER TEKNIK	http://www.polimerteknik.com
RCT	http://www.rctsrl.com
ROSSETER	http://www.e-nanoscience.com
SCC	http://www.scconsultants.com
TREFFERT	http://www.treffert.org

Research Organisations

EINDHOVEN UNIVERSITY OF TECHNOLOGY	http://www.mate.tue.nl
FRAUNHOFER-ICT	http://www.ict.fraunhofer.de
SMITHERS RAPRA	http://www.rapra.net
UNIVERSITY OF BIRMINGHAM	http://www.bham.ac.uk

Associations

ASSOCOMAPLAST	http://www.assocomaplast.org
CCIAA	http://www.mi.camcom.it
BPF	http://www.bpf.co.uk
GKV	http://www.gkv.de
PAGEV	http://www.pagev.org.tr

For more information, please visit the project website:
http://www.peptflow.com

SIXTH FRAMEWORK PROGRAMME

The PEPT-Flow project is supported by funding under the Sixth Framework Programme of the European Union.
Contract No COLL-CT-2006-030191.

PEPT-Flow

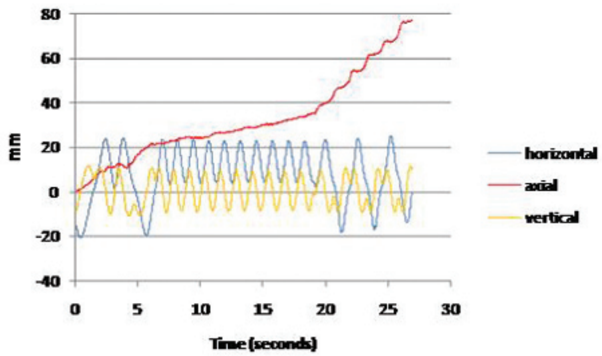
An Innovative Polymer Flow Visualisation Technique

Summary

The PEPT-Flow project applies the flow analysis technique of positron emission particle tracking (PEPT) for the investigation of polymer flow and mixing behaviour within industrial twin-screw processes, determining the influence of machine design, process operation and polymer system.

The results generated will be used to...

- Aid machine design
- Offer operational guidelines
- Develop new simulation software
- Add to existing modelling programmes
- Improve mixing and process efficiency
- Obtain energy reductions



The figure shows the horizontal, axial and vertical position of the particle vs. time as it moves through the extruder window.

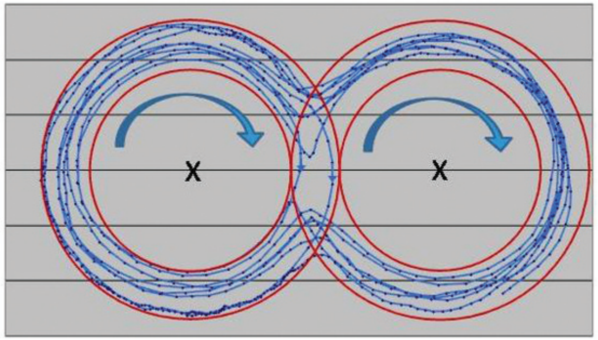
PEPT FLOW

Technical Update

Successes so far include:

- Real-time particle trajectories recorded as tracer particle moves with polymer through the extruder.
- A visibility window of about 90mm in length (equivalent to over 3 screw diameters) attained.
- Data frequency of up to 200Hz (equivalent to 9° of shaft rotation at 300rpm) achieved.
- The tracer separation device installed after the pelletiser. A Geiger counter detects the particle in the strand as it enters the pelletiser and, after a suitable delay, activates the separation flap to divert the stream of pellets to a collection box from which the active pellet can be straightforwardly recovered using the Geiger counter.
- Reasonable "survival rate" of tracer particles achieved. Several passes accomplished by each tracer particle.
- Ability to count particle passes over high shear region of the flight and thus assist with prediction of dispersive mixing.
- Measurement of residence time distribution through a screw element, by running 30 or more passes, to give an indication of distributive mixing.
- Generation of data showing the influence of downstream restrictions, such as reversing elements, on residence times and passes over high shear regions.
- Calculation of particle velocities that fall in line with expectations.

Cross section of 27mm extruder viewed from the die side.



The diagram shown above is the result of one run of the PEPT particle through a set of kneading paddles set at 30°, 60°, then 90°. By superimposing the actual diameter of the barrel and the root diameter of the screw over the points observed we can see the accuracy of the technique.

We can observe various things from the particle trace:

- The left hand screw has eight complete paths whereas there are only six around the right hand screw.
- The two paths that go between the screws are both complete circuits of the left hand screw.
- There is also a collection of points at the bottom of the left hand screw implying that material tends to spend longer in this region than in any other region.

These observations confirm earlier work by other researchers that the left hand screw takes more power than the right hand screw, as viewed above.

Another interesting observation is the way that the path around the top of the right hand screw seems to follow a central track, almost as if it is conveyed by the central portion of the kneading disc, neither adhering to the screw root nor the flight tip.

Many calculations can be made from the data produced including average residence time, residence time distribution, velocity, and less accurately, acceleration of the particles.