

# DRAFT REPORT FOR THE PLASTINDIA INTERNATIONAL UNIVERSITY WEBINAR ON “NEWER SYSTEMS FOR MELT COMPOUNDING POLYMER SYSTEMS” OCT 13TH, 2022

As per part of a joint program between Plastindia International University, PIU, and UMass Lowell, the eighth webinar on “Newer Systems for Melt Compounding Polymer Systems” was delivered by Prof Carol Barry on Oct 13th 2022 06:00 PM (IST) / 08:30 AM (EST) onwards.

**Ms Shreyal Dhume** on behalf of Plastindia International University, welcomed all the attendees. She briefly reviewed the earlier webinars presented by Prof Wan Ting Grace Chen, Prof David Kazmer, Prof Stephen Driscoll, Prof Amir Ameli, Prof Davide Masato, Prof Nagarajan and Prof Meg Kline.



Jacqueline White, Manager of Corporate Training & Education introduced Prof Carol Barry who was the speaker for the eighth webinar. Dr. Carol Barry is a Professor and the Chair of the Department of Plastics Engineering at UMass Lowell. She had 12 years in industry prior to joining the Plastics Engineering faculty. Her research focus is plastics processing, including extrusion, injection molding, and novel processing techniques.

Recent work has focused on Nano manufacturing with polymers, including compounding and forming of polymer and rubber Nano composites, co-extrusion of multilayer films, injection molding and embossing of micro and nanostructured surfaces, and template-directed assembly and transfer of Nano elements, and evaluation of mixing equipment. She has over 100 publications.



Prof Carol Barry introduced the importance of compounding in polymer industry. She observed that twin screw compounding extruder is being used most commonly. The most important criteria are uniform mixing and desired concentration of dispersed phase. The throughput of twin screw extruder can be limited by intake capacity of screws, difficult-to-handle materials, air entrainment and issues with melting and mixing.

The intake capacity can be enhanced by increasing the OD/ID of elements. The standard design has OD/ID ratio 1.55:1. The modifications of using co-rotating TSEs with recycled materials can be TSE to gear pump to sheet die. Air entrainment can be reduced by providing vent at appropriate position and design. The issues with melting and mixing have been addressed by newer designs of screw elements. The speed can be as high as 4,400 RPM. The screw designs have been modified considerably for high speed extruders.

The triple screw extruders are also being used for compounding. The three parallel screws have fully-intermeshing co-rotating screws, bilobal and trilobal elements. The L/D ratio is from 36 to 52 (bilobal) and 32 to 64 (trilobal).

Its applications are greater output, better mixing of fillers and of colour masterbatches as well as repelletizing regrind/recycle of PE, PP, and PET.

## Triple Screw Extruders

12

For non-parallel triple screw extruders with trilobal elements and fully intermeshing co-rotating screws need special gearbox. The L/D ratio is from 20 to 60. The plastication in triple screw extruder is much superior to in twin screw extruder.

Quad screw extruders have four parallel screws for bilobal elements and fully-intermeshing co-rotating screws. L/D ratio is from 10 to 150. Commonly used ratio is about 45. The speed is less than 2200 RPM. She explained the effect of temperature zone and speed on degree of mixing. She presented some data on different systems such as reprocessing of PP, fibre filled LDPE and degradation of PLA.

Octa screw extruders have 8 screws. For eight parallel screws with bilobal elements and fully-intermeshing co-rotating screws, L/D ratio can be from 10 to 150. She also explained continuous mixers with examples such as HDPE / CaCO composite, PLA/ talc composite, PP/PA 6 blends. She presented different designs of continuous mixers. She gave a brief overview of planetary extruders. Some of the applications of planetary extruders are continuous compounding of rubber, pharmaceutical compounding and bottle-to-bottle recycling of PET. Throughput can be up to 4,000 KG per hour.

She briefly explained gear extruders and reciprocating screw extruders. The types of such extruders can be kneader or co-kneader. Split barrel provides better cleaning.

Prof Dr DD Kale thanked Prof Carol Barry for covering a very vast subject in a very simple way. Prof DD Kale conducted the Q&A session by forwarding the questions of relevance to the speaker. The vote of thanks was presented by Dr DD Kale.

