GENERAL DYNAMICS
Ordnance and Tactical Systems–Canada Valleyfield

Continuous Celluloid Twin Screw Extrusion Process

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Due to its thermoforming and combustion characteristics, celluloid is a very interesting product for the armament industries. Applications such as mortar increment made of celluloid sheets have been used as a container for propellants for decades.

There are two processes currently used in order to produce celluloid sheets on an industrial scale. The block method, in which a uniform block of celluloid is compounded using a kneader , roll mill and then cut into thin individual sheets. The solvent cast method in which the celluloid is dissolved in lacquer, cast on a conveyor belt and dried. Both manufacturing methods have disadvantages (Table 1).

Table 1: Advantages/Disadvantages of current celluloid manufacturing processes and proposed TSE manufacturing process.

Block Method	Solvent Cast Method	TSE Methods
Pros: -Consistent thickness (0.2 – 3 mm) -Can incorporate solid particles Cons: -Batch process includes many steps -High overhead	Pros: -Continuous casting process -Low overhead Cons: -Thicker sheet is limited by solvent evaporation -Sedimentation of solid particle	Pros: -Continuous process -Higher viscosity is achievable compared to cast process -Uniform thickness of sheet -Variety of shape (strands, profile extrusion etc.) Cons: -Feeding of of raw materials (NC, Camphor)

For these reasons GD OTS Canada Valleyfield has developed a method for continuously compounding celluloid using a Twin Screw Extruder (TSE) approach [1].

TSE film extrusion follows the following steps (Figure 1, 2 and 3):
-Feeding of celluloid in the extruder either as compounded pellets or using the raw material (dehydrated NC fibers, camphor and solvents).
-Compounding of raw material or pellets dissolution in the extruder.
-Extrusion of celluloid sheet using a sheeting die.
-Calendaring using 3-roll stack.
-Solvent extraction.
-Collecting the film.

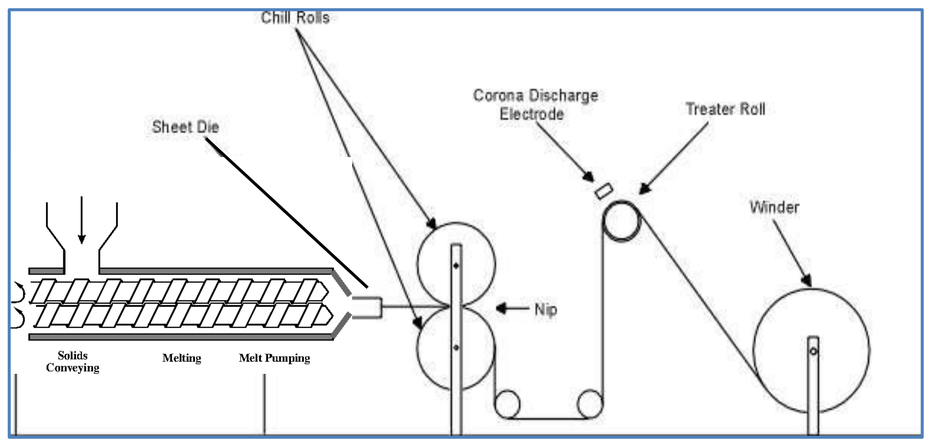

Figure 1: TSE film extrusion process diagram.

Metering NC fibres requires use of specialized Loss-in-Weight feeder. Conical side is needed to increase the bulk density of NC to ensure a good feed to the TSE (Figure 2).

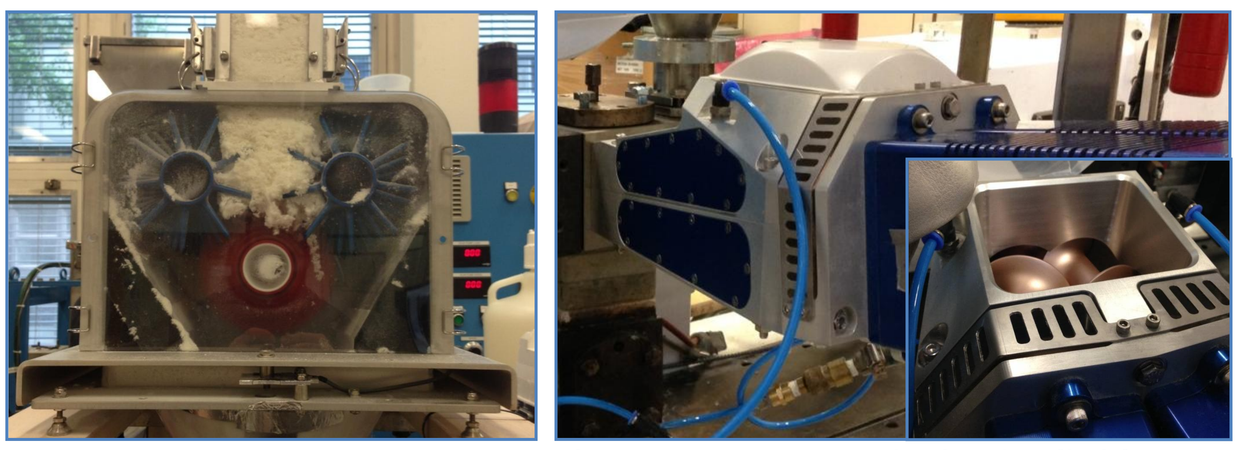

Figure 2: Proprietary equipment for NC Loss-in-Weight feeder (left) and jacketed conical side feeder for 27mm Leistritz Extruder (right).

Compounded celluloid beads can easily be fed using screw feeders (Figure 3).

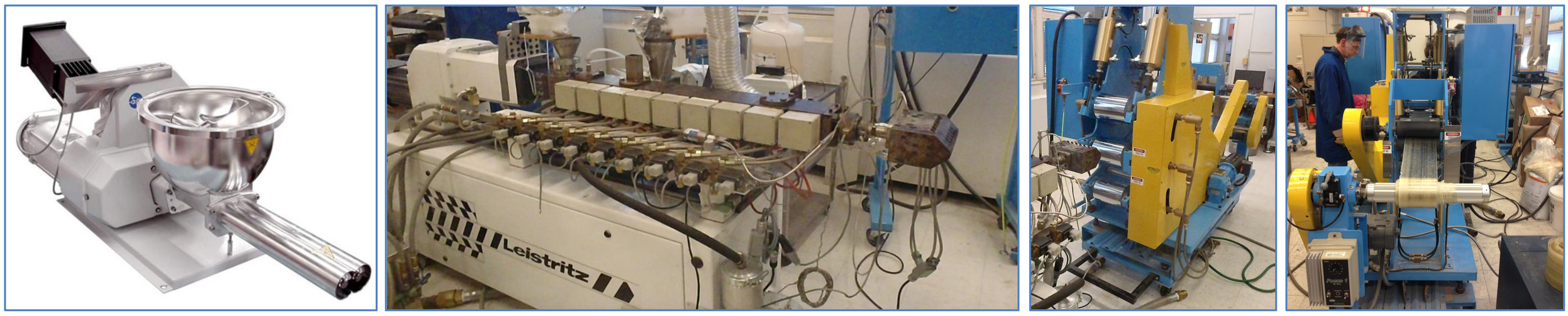

Figure 3: Screw feeder (left), 27 mm Lesitritz Extruder with 6” slit dies (center-left), 10” 3-roll stack (center-right), film collector (right).

1- Dubois. C., Comtois. E. U.S. 20150042008 A1, filed on Jan 29, 2014.