Chapter - 6

CONCLUSION

1. Flow of recycled nylon pellets in a reciprocating injection molding machine was studied.

2. It was established that high shear of partially melted plastic (a form of molten plastic among closely packed nylon pellets gives high viscous friction) which was formed near to the barrel wall, stopped the down channel flow through the compression zone. Phenomenon called "stationary rotation" was observed. It occurred when plastic did not slip, but was firmly fixed on the screw surface and merely rotated together with screw at the same position. This circumstance made it impossible to perform injection moulding process, infinite recovery time.

3. It was found that small quantities of low molecular weight polyethylene improved flow properties of recycled nylon by acting as an external lubricant and internal lubricant as well. Polyethylene reduces friction between nylon and metal surfaces, and between nylon particles. Plastic particles(nylon) started relative movements with each other, barrel inner wall and screw surface. Drag flow from hopper to front chamber of the barrel through helical channel appeared. As recovery time became equal to few seconds and injection moulding process was performed automatically.

4. Experiment carried out on torque measuring mixer conformed effect of polyethylene and Zinc-stearate, on the flow properties of recycled nylon 6, by decreasing in torque of nylon plus polyethylene and nylon plus Zinc-stearate mixtures compared to pure recycled nylon.

5. Certain improvement of flow properties of recycled nylon achieved by introduction of small quantity of polyethylene could be attributed to decreasing in the degree of crystallinity of nylon as Vicat softening point of nylon plus polyethylene used was 5 ^{0}C below than that of pure nylon.

6. There was no significant effect to the final product(nylon washer) quality requirement due to addition of 0.8% polyethylene.

7. Further investigation of the mechanism which has been introduced for the explanation of the function in delay zone will be an advantage to develop a mathematical model.

8. Another aspect of this research is related to environmental protection problems. Being non biodegradable by nature, nylon plastic waste created serious problems to the environment. So carried out research is helped to convert industrial waste in to useful product.

APPENDIX

A. Some Important Physical Data Of Polymer Processing :

A.1 Practical Melt Viscosities :

The polymer melts are :

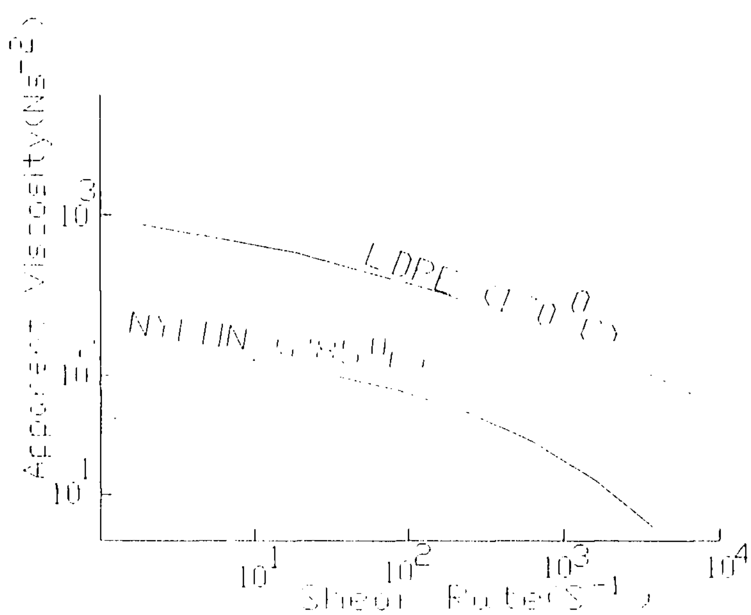
- non-Newtonian
- usually shear thinning
- decrease in viscosity with increasing temperature

The effect of these factors to nylon and polyethylene(LDPE) are illustrated as following way in fig. 3-1 and fig. 3-2. (POLYMER PROCESSING, Morton – Jones D. H., 1989)

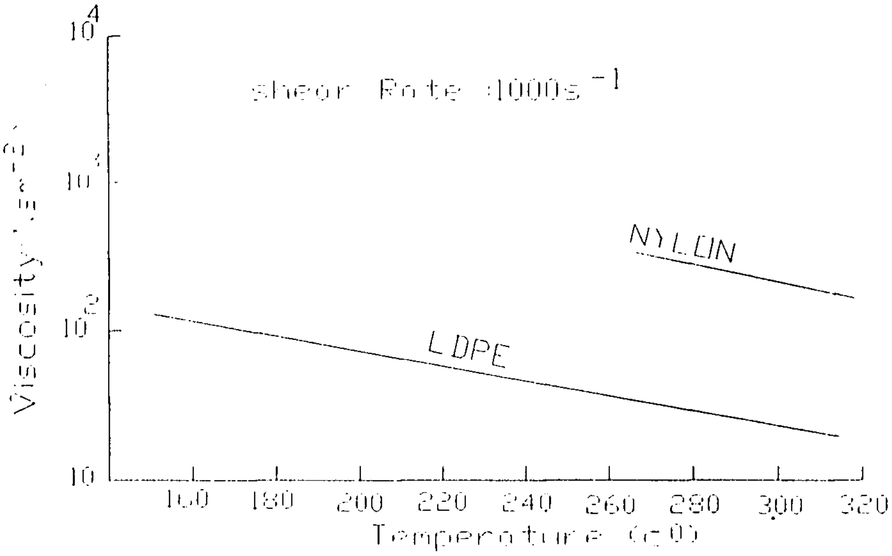
The polymer(LDPE and nylon) melt viscosities at different temperatures and at constant shear rate can be mention as follows. (POLYMER PROCESSING, Morton – Jones 1989)

table A-1

Apparent viscosity (Pas) at shear rate (γ°) = 10^3 s^{-1} and at temperature (C^0)										
Material	150	170	190	210	230	250	270	290	310	360
LDPE	115	85	65	50	40	30	25	20		
Nylon 6,6							115	80	55	



apparent viscosity Vs. shear rate , **Fig. A-1**



effect of temperature on polymer viscosity, **Fig. A-2**

Shear Rates Of Different Processes :
(Morton – Jones, 1989)

table A-2

process	Shear rate (s^{-1})
Injection moulding	$10^2 - 10^3$
extrusion	$10^3 - 10^5$

Heat Penetration Thickness And Thermal Diffusivity Of Polymers :
(Agassant et al. 1991)

The thermal diffusivity (α) of polymers is about 10^{-7} m^2/s, which yields the following approximate values for the penetration thickness as a function of time. More generally, the penetration thickness increase with the square root of time (t). The time at which most of the temperature difference is felt at a distance y is of the following order.

$$t = y^2/\alpha$$

table A - 3

y	$t = y^2/\alpha$
0.01 mm	0.001 s
0.10 mm	0.100 s
1.00 mm	10.00 s
10.0 mm	1000 s

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