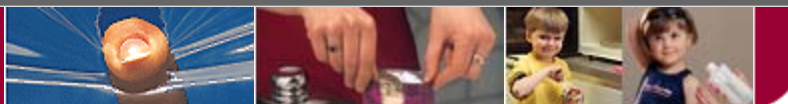


Product Information

Disco Purge Procedure



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The Disco Purge Procedure for Extrusion Coaters

Surlyn® packaging resin
Nucrel® acid copolymer resin

Background

Purging can be defined as replacing one resin in an extruder with another. It can involve direct transitioning from one resin to a different one, or using a purge resin such as DuPont Polyethylene 6611 to remove the first resin from the machine prior to introducing the second resin. There are many documented cases of customers having purge problems. They include gels and black specks, using a thousand pounds of resin to get the web clear before a production run can be made, and not getting a "pure" copolymer surface and having seal problems. However, there are just as many or more success stories of customers with these kinds of problems using the Disco Purge method with improved efficiency and quality.

In a DuPont study, the Disco Purge was found to be the best procedure to get a complete purge, both in terms of speed and also the amount of resin used. We suggest you evaluate the Disco Purge first with a purge such as pigmented LDPE to clear LDPE. If your total purge time and pounds used are reduced, try it with Surlyn® or Nucrel® and Nucrel® or Nucrel®. The procedure costs little to evaluate and isn't complex, other than requiring operator attention.

Procedure

The Disco Purge technique is quite simple, but does require operator attention for the purging period. The following chart can be used as a convenient reference for the operator. Only the maximum RPM and a few calculations are needed to fill it out.

WORKSHEET for Disco Purge Procedure					
MAXIMUM EXTRUDER RPM = _____ RPM					
1st min:	30% of max =	0.3	×	_____ RPM =	_____ RPM
2nd min:	90% of max =	0.9	×	_____ RPM =	_____ RPM
3rd min:	50% of max =	0.5	×	_____ RPM =	_____ RPM
4th min:	15% of max =	0.15	×	_____ RPM =	_____ RPM
5th min:	70% of max =	0.7	×	_____ RPM =	_____ RPM
minutes 6-10:	15-20% of max =	0.15	×	_____ RPM =	_____ RPM
		to 0.2	×	_____ RPM =	_____ RPM
minutes 11-15: Repeat the cycling steps of the first 5 min.					

Begin the Disco Purge after the old material is removed from the extruder hopper and the new material is put in. Then cycle the screw RPM the following way:

- 1st minute at 30% of maximum RPM
- 2nd minute at 90% of maximum RPM
- 3rd minute at 50% of maximum RPM
- 4th minute at 15% of maximum RPM

- 5th minute at 70% of maximum RPM
- minutes 6-10 at 15-20% of maximum RPM
- minutes 11-15 -- repeat the cycling steps of the first 5 minutes

The specific RPM values and times are not important. What is important is disrupting the flow patterns and establishing new velocities and shear rates. One minute at each RPM is sufficient to do this. At lower RPMs the polymer that is adhered to the metal or stuck in a corner has a chance to bond with material that is in the mainstream. At higher RPMs the velocity of the material on the walls is higher and more of the polymer on the walls can be pushed out. Periods of high output are essential to an effective purge.

More than one 15-minute cycle is sometimes required for extrusion coater purging and more than two or three cycles is recommended for blown film extruders. Blown film extruders generally take much longer to purge because of the more complicated die design.

Purge Study

To evaluate the Disco Purge procedure, a purge study was done on the extrusion coater at DuPont's Technical Services Laboratory (TSL). The coater's extruder was 4-1/2 in., with a 28:1 L/D. The study involved four common purge techniques, using three resins. The purge techniques evaluated were:

- a "let it run" purge, where the old resin is purged out at constant RPMs and no extruder conditions are changed when the new resin is introduced;
- the Disco Purge described above;
- a rough Disco Purge where the screw speeds are cycled between 90% and 10% of maximum only for 5 minutes, held constant for 5 minutes, then cycled again for 5 minutes; and
- DuPont Polyethylene 6611 is used as a purge compound according to STL #67-5

All of the purge techniques except the 6611 purge were evaluated at 1.) simulated start-up where there is LDPE in the system and the Surlyn® or Nucrel® is purging it out; and 2.) simulated shutdown where LDPE would be used to purge out the Surlyn® or Nucrel® in the extruder at the end of a run. The difference between these simulated cases and normal extruder operation was that for case 1, the extruder wasn't cold before the "start-up," and for case 2, the extruder wasn't cooled off after the "shutdown." The 6611 purge method was only evaluated at shutdown conditions. Purge compounds in general are discussed separately in a later section.

Resins Used

- Surlyn® 1652
MI=5.0 g/10 min
- Nucrel® 1207
MI=7.0 g/10 min
- DuPont LDPE 1540
MI=6.5 g/10 min

The LDPE 1540, which is the normal purge resin for the extrusion coater at TSL, was colored white with a PE-based color concentrate so transitions would be easier to see and quantify.

Shutdown or Purging from Copolymer to PE

LDPE 1540 was found to be an excellent purge resin for shutdown. Because it is more viscous at the melt temperature (550°-580°F) than Surlyn® or Nucrel®, it pushes the materials out quickly and thoroughly. Because of this difference in viscosity all techniques produced similar results in the simulated shutdowns, i.e., using 1540 to purge out Surlyn® and Nucrel®. On average, it took 15 minutes to purge our 4-1/2-inch extruder and 100 pounds (45 kg) of PE were used.

Start-up or Purging from PE to Copolymer

The differences in the purge procedures were more apparent in the simulated start-up, where the Surlyn® and Nucrel® were used to purge out the 1540 in the system. The Disco Purge worked best. It used 175 pounds (79 kg) and took 25 minutes on average.

The rough Disco Purge was run for comparison purposes to determine whether or not the cycling of screw RPMs in the Disco Purge (30%, 90%, 50%, 15%, 70%) is important, or if the same result could be achieved by just cycling high and low RPMs (90%, 10%). The rough Disco Purge was not as effective, so it is important to cycle at intermediate RPMs. The rough Disco Purge took about 20% more time to purge to the same point, and also used 10% more material.

The "let it run" purge at 45 RPMs (maximum screw RPM was 270) was the least effective on the simulated

start-up. At the faster rate of 135 RPM, the "let it run" purge can give a 20% time savings over the Disco Purge, but at a cost of 30% more resin. Neither "let it run" purge attained a rating of 10 (best possible) for quality of purge as the Disco Purge did.

Purge Compounds

Using a purge compound like DuPont Polyethylene 6611 or Rapidpurge* involves flushing the system with PE after running Surlyn® or Nucrel®, then adding 50-100 pounds of purge compound (6611 in this case), then purging the 6611 with PE. Polyethylene 6611 contains a blowing agent which foams when heated and a silica scrubbing agent.

*Rapidpurge is a registered trademark of the Rapidpurge Company.

Purge compounds in general do an excellent job cleaning the extruder, but purging them out can be difficult. Purging the 6611 purge compound took much more resin (500-800 lb of 1540) than the other procedures, and after almost twice as much time as the others, there was still some 6611 grit in the web. However, there are occasions when purge compounds should be used, i.e., if there is degraded polymer in the system or when a particularly thorough cleanup is required.

Rating System

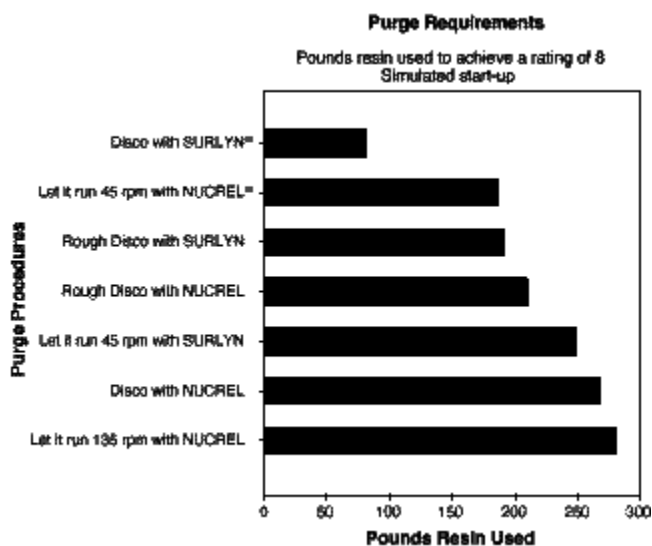
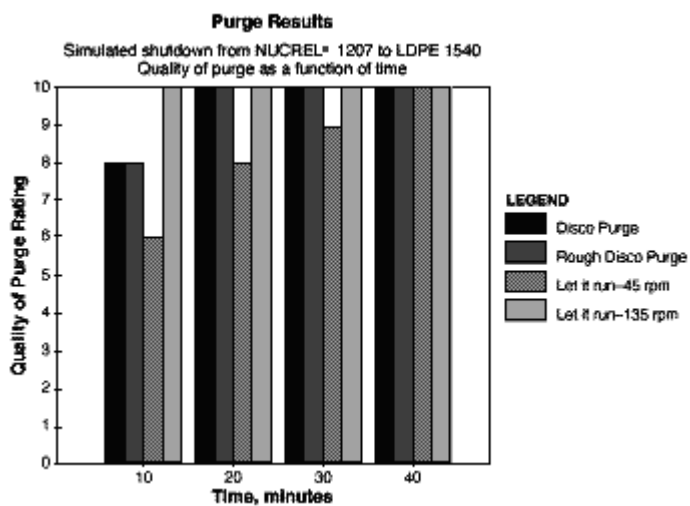
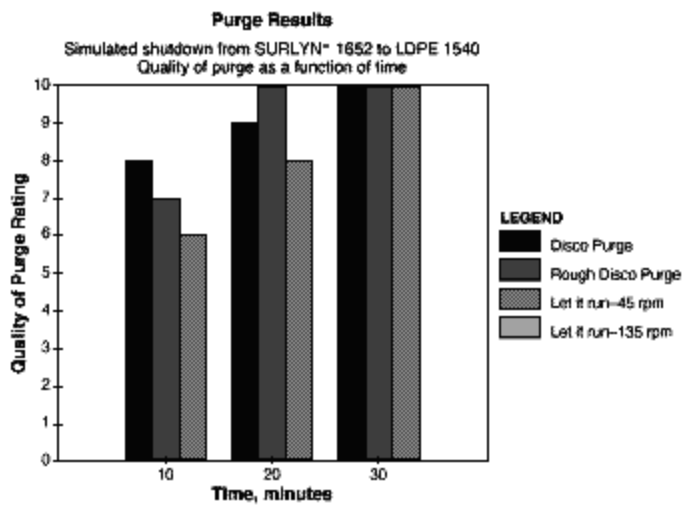
On the attached graphs a rating of 8 or more was considered well enough purged for a commercial run. A perfect rating of 10 indicated that the purge was complete, including the outside edges that are always the last to be purged in an extrusion coater. The rating system is based on notes taken every one to two minutes as to how much color (from the pigmented PE) was present in the web. The last two graphs are charts of how much resin is required for each purge to reach a rating of 8. This could be important when starting to run an expensive resin. The 6611 purge is not included on any of the charts because it required considerably more time and resin than any of the other procedures.

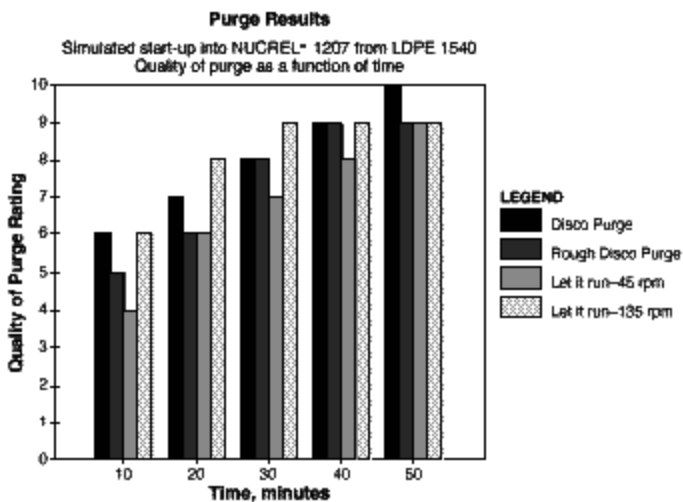
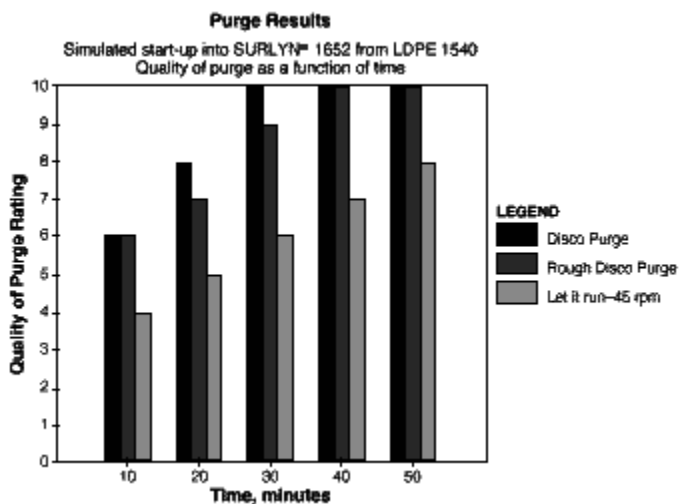
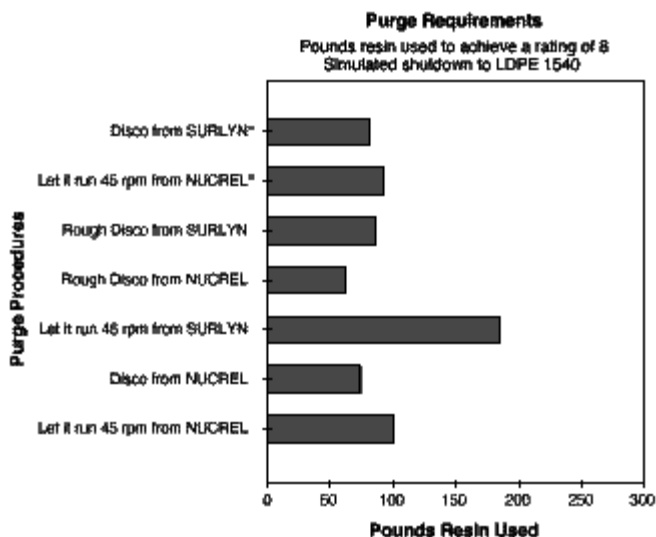
Ratings Scale

For clear Surlyn® or Nucrel® following white PE		For white PE following clear Surlyn® or Nucrel®	
To achieve a rating of	Observable conditions	To achieve a rating of	Observable conditions
0	New resin not through yet	0	White PE not through yet
1	Just starting to see new resin	1	Just starting to see white
2	Web still very cloudy	2	Still see clear areas in middle
3	Can discern some clear areas	3	>1-in. of clear on either edge
4	>6-in. of white on either side, or web still cloudy	4	$\frac{1}{2}$ -in. to 1-in. of clear on either edge
5	>5-in. of white on either side	5	$\frac{1}{8}$ -in. to $\frac{1}{2}$ -in. of clear on either edge
6	>4-in. of white, film mostly clear	6	< $\frac{1}{8}$ -in. on both edges
7	>2-in. of white, center line* faint	7	Thin line of clear on both edges
8	<1-in. of white visible	8	Very hard to see clear on edges
9	Center line* gone, edges just milky color	9	Edges milky color
10	Film all clear	10	Completely white

* Center line due to a dead zone in front of blunt extruder screw tip.

DuPont Purge Study Results





CAUTION: Do not use in medical applications involving permanent implantation in the human body. For other medical applications, see ["DuPont Medical Caution Statement"](#), H-50102.

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