

Options to Aid Extruder Screw Removal and Cleaning

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Abstract

All extruder screws will have to be removed at some time for various reasons. These reasons can include periodic screw and barrel maintenance, screw type change, or to simply clean your extrusion system. This paper will compare and contrast different materials to aid in the removal and cleaning of your extruder and screw by measuring ease of pulling screw, ease of cleaning, price of material and time to clean.

Introduction

The purpose of this paper is to relay information found while experimenting with various “purging compounds” that could aid in the removal as well as the cleaning of an extruder screw, saving both time and money. Extruder screw removal is required for a number of different reasons including, but not limited to, measuring wear, upgrades, or to clean screw and barrel. They can be removed by using mechanical screw puller/pusher, forklifts (pushing or pulling) chain hoists/come-along, or hydraulic presses. Using a numerical ranking system, seven different “purge materials” were evaluated. The following tasks were evaluated – ease of pulling screw and the ease of cleaning same screw. In addition to this, time to clean, price/lb., and author’s order of preference was generated.

Materials

The “purging compounds” used in this work consists of thermoplastic polymers some of which could be polyethylene based, acrylic based, or a combination of each. In addition, some of these could contain proprietary additives. The following descriptions of the “purge material” will be used in this paper:

LDPE
HDPE
Acrylic Purge Blend
PVC (plasticized)
Purge Compound #1
Purge Compound #2
Purge Compound #3

The extruders used for this work are part of the Egan Davis-Standard pilot cast film line located at Pack Studios in Freeport Texas. The Egan Davis Standard MAC

extruders (air cooled) used for this work have a diameter of 2.5 inches with a 30:1 L/D ratio. The screws for this particular extruder are removed from the back of the barrel and can be described as moderate shear single flight screws with Egan spiral mixer.

Procedure Protocol

The following steps were taken for all materials:

1. Used the 2.5” extruders for experiment
2. Disconnected extruders from adapter pipes
3. Started all runs with LDPE in extruder
4. Slowly turned extruders at 10 rpm until LDPE stopped exiting then added the “purge material”
5. Added approximately 2.5 gallons of “purge material”
6. Continued slowly turning extruders until nothing was being conveyed
7. Pulled screw out using chain come-along until we could easily pull screw out manually
8. Cleaning begins

Note: Three different extruder temperatures were used due to the extreme differences in the materials. Purge Compounds #1 and #3 were elevated for two reasons – manufacturer recommendation and to lower motor amps on extruder. The plasticized PVC temperature was lowered to ensure no decomposition occurred which could damage equipment due to the release of Cl₂.

LDPE	350°F
HDPE	350°F
Acrylic Purge Blend	350°F
PVC- plasticized	300°F
Purge Compound #1	400°F
Purge Compound #2	350°F
Purge Compound #3	400°F

Figures and Tables

A plan was needed to measure the ease of pulling and cleaning the screw once it was removed, so the following numerical ranking system was developed. Using a team of three different laboratory technicians, the following system was utilized to quantify ease or difficulty when removing and cleaning the extruder screw.

Numerical Ranking System (values assigned by team)

- 1- Very easy
- 2- Easy
- 3- Moderate
- 4- Difficult
- 5- Very Difficult

Although this system is somewhat subjective, all team members agreed it represented the tasks accurately and agreed all samples were able to be differentiated from each other. The following table was generated utilizing this numerical ranking system.

	LDPE	HDPE	Acrylic Purge Blend	PVC (plasticized)	Purge Compound #1	Purge Compound #2	Purge Compound #3
Ease of Pulling Screw	5	3	4	1	1	3	3
Ease of Cleaning Screw	5	3	2	1	1	4	1
Price/lb	.70 - .85	.65 - .80	2.50	2.00 - 7.00	1.95 - 2.80	2.10 - 4.00	6.25 - 8.50
Time to Clean (man min.)	45	15	12	9	1	15	1
Order of Preference (ease to remove and clean)	7	5	4	2	1	6	3

Discussion

Although any of the above “purging compounds” could work, there are definitely advantages of some over the others. As shown in the above table, the fabrication team also ranked the different materials in order of their preference. It is quite easy to see the differences between the first ranked and seventh ranked materials. The only downside with Purge Compound #1 compared to the LDPE is the slightly higher cost. Since it took 45 minutes to clean the LDPE screw and only one minute to clean the Purge Compound #1 screw, the savings in labor costs easily pays the difference between the two materials. It is important to note that although these materials could be used to clean an extruder, this study was only focused on the ease to remove

and clean the screw off. If we were looking strictly at the ability of a “purge” material to clean a system, it is quite possible the end results could have looked different. More contrast and comparison is discussed in the next section.

Conclusions

As far as time savings and effort, purge compound #1 is the preferred material. PVC (plasticized) was near the top, however, a much tighter processing window needed for the PVC. Purge Compound #3 was next due to being a little more difficult to remove screw. The acrylic purge blend and HDPE were somewhat comparable in performance as far as removal of screw and cleaning, however, the acrylic purge blend took slightly less time to clean. Purge compound #2 was a little more difficult to remove and clean than the previous materials. LDPE was the most difficult to extract from extruder and remove from screw surface, thus requiring the most labor time.

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