Purging with In-house Thermoplastic Resins vs. Commercial Purging Compounds

Performance test results of In-house Resins used for purging and Dyna-Purge M engineered purging compound:

- Polypropylene (PP)
- Polyethylene (HDPE)
- Polycarbonate (PC)
- Acrylonitrile Butadiene Styrene (ABS)
- Dyna-Purge M

Conducted by Diamond Polymers, Inc., Akron, Ohio

Commissioned by Shuman Plastics, Inc., Dyna-Purge® Division, Depew, New York

Comparative Testing of Purging with In-house Resins vs. Dyna-Purge M

Commercial purging products were introduced as an alternative to in-house resins and regrinds in the 1980s. At first, these products were met with the usual skepticism experienced with any new technique. However, over time an increasing number of companies switched to commercial purging methods due to the rising costs of resins and the drive to increase productivity. Today, the effectiveness and economy of these products have been proven in all major categories of plastics operations, including injection molding, extrusion, compounding and blow molding. Although virtually any commercial purging product may be considered an improvement over in-house resins, many companies continue to use such resins with the preconception that this is the less expensive alternative for purging.

Abstract

Diamond Polymers, Inc. of Akron, Ohio conducted independent, comparative testing of four types of in-house resins and Dyna-Purge M engineered purging compound on February 7, 2008. All the trials were conducted on a Battenfeld BA600 60-ton injection molding machine. The study was commissioned by the Dyna-Purge® Division of Shuman Plastics, Inc.

The trials compared the effectiveness, time-to-purge, cost-to-purge and scrap rate of purging with PP Natural - 12 Melt, HDPE Natural - 12 Melt, PC Natural - 14 Melt and ABS Natural - 10 Melt resins vs. Dyna-Purge M, a mechanical (non-abrasive) thermoplastic commercial purging compound. Dyna-Purge M was developed for use with a wide range of resins for injection molding and extrusion applications that have a temperature range of 350˚F to 600˚F (177˚C to 315˚C). **The test results proved that Dyna-Purge M lowers purging costs by 62% to 87% compared to the four in-house resins.**

Dyna-Purge M lowers purging costs by:

- **87% vs. purging with PP**
- **82% vs. purging with HDPE**
- **73% vs. purging with PC**
- **62% vs. purging with ABS**

For complete results turn to page 7.

Why purging is integral to plastics processors

Purging is necessary for several reasons. The most obvious would be the need to change color or resin when shifting production from one product to the next, or to clean out the machine for periodic preventive maintenance.

Purging helps eliminate streaking, which occurs when old color is trapped in a negative flow area without enough physical turbulence to remove the color. The next material processed picks up trace amounts of the residue color, causing a streak in the part.

Another key reason to purge is to remove carbon buildup or black specks. These may be caused by any one of the following: "dead spots" or negative flow areas in the barrel, nozzle or die; hot temperature spots in the machine; separation of additives, fillers and color concentrates from the carrier system that are left behind when the resin is processed; and/or degradation of polymers during start-up and shutdown, excess heat, shear action or residence time in the barrel.

Carbon buildup may adhere to the walls of the machine, screw surface and manifold channels. The carbon will eventually break off and move forward, ending up as black specks in the finished product.

Since in-house resins are not formulated to clean the machine, they are not effective when employed for purging. They attempt to displace the resident material, requiring five to ten times more resin to purge than a commercial purging product. This time-consuming process results in substantial machine downtime, generates an excessive amount of scrap and is inconsistent due to material and operator variability.

Why Commercial Purging Compounds are more effective than In-house Resins

Commercial purging compounds provide a more effective solution. Specifically formulated to clean plastic processing equipment, commercial purging compounds offer these key benefits:

Less downtime

Purging products are formulated to clean on the first pass through the screw and barrel, minimizing machine downtime and maximizing productivity.

Reduced scrap

Using a purging product eliminates the need to waste usable resin to achieve color or material changes. Eliminating black specks and color streaking results in fewer rejected parts.

Greater consistency

Using a commercial product and following the manufacturer's purging procedure leads to better, more consistent results, minimizing the impact of both material and operator variability.

Lower purging costs

Calculating the expense of in-house resins vs. the purging product used, plus the labor involved to purge and post-purge, commercial purging compounds significantly lower the cost-to-purge.

A comparative study

Diamond Polymers, Inc. tested four types of in-house resins: PP, HDPE, PC and ABS vs. Dyna-Purge M. A protocol was developed and applied for each test trial:

Trial Protocol:

- Run 100 grams of black resin
- Purge until clean and natural in color
  - Measure and record amount of purge used
  - Measure and record time-to-purge
- Post-purge with white resin until no purge is evident
  - Measure amount of post-purge resin
  - Measure time to post-purge
- Produce parts until a part is visibly comparable to control part
  - Record number of scrap parts made
  - Record weight of scrap parts
- Photograph purge and parts

Control Parts:

- Prior to each trial, a white control part was molded for comparison purposes

Cost-to-Purge:

In each test, the cost-to-purge was calculated by:

- The amount and cost of purging product used
- Machine downtime (based on $76.19 per hour)
- The amount and cost of post-purge resin used
- Post-purge time lost (based on $76.19 per hour)
- The amount of time and material used until quality part produced

Sources of Comparative Data

Data	Source
Machine Downtime: $76.19 per hour	Plastics Technology, 2008 Median Machine Hour Rate
Resin Pricing (per lb.): PP: $0.97, HDPE: $0.91, PC: $1.76, ABS: $1.01	Plastics News, Volume Category II, February 2008
Dyna-Purge M: $2.50 per lb.	Dyna-Purge® Published Price List
Time to make one good part: 32 seconds	Diamond Polymers, Inc. Control Part

Trial 1: Black PP to White PP: 12 Melt

Processing Temperature: 420˚F (216˚C)

	Dyna-Purge M		PP Natural	
	Results	Total Cost	Results	Total Cost
Amount of product required (grams)	200	$1.10	500	$1.07
Purging time (sec.)	50	$1.06	105	$2.22
Post-purging resin (grams)	47	$0.10	67	$0.14
Post-purge time (sec.)	9	$0.19	12	$0.25
No. of scrap parts	0	–	20+*	–
Time to good parts (sec.)	0	–	640	$13.54
Weight of scrap parts (grams)	0	–	709.6	$1.53
Total cost-to-purge		**$2.45**		**$18.75***

* NOTE: There was still contamination after 20 molded parts. Therefore, total cost-to-purge is more than $18.75.

The first part produced after purging with Dyna-Purge M was clean and free of contamination. Purging with PP resin did not lead to clean parts after 20 parts were molded.

Trial 2: Black HDPE to White HDPE: 12 Melt

Processing Temperature: 450˚F (232˚C)

	Dyna-Purge M		HDPE Natural	
	Results	Total Cost	Results	Total Cost
Amount of product required (grams)	200	$1.10	500	$1.00
Purging time (sec.)	54	$1.14	107	$2.26
Post-purging resin (grams)	46	$0.09	52	$0.10
Post-purge time (sec.)	9	$0.19	12	$0.25
No. of scrap parts	1	–	20+*	–
Time to good parts (sec.)	32	$0.68	640	$13.54
Weight of scrap parts (grams)	37	$0.07	729.5	$1.46
Total cost-to-purge		**$3.27**		**$18.61***

* NOTE: There was still contamination after 20 molded parts. Therefore, total cost-to-purge is more than $18.61.

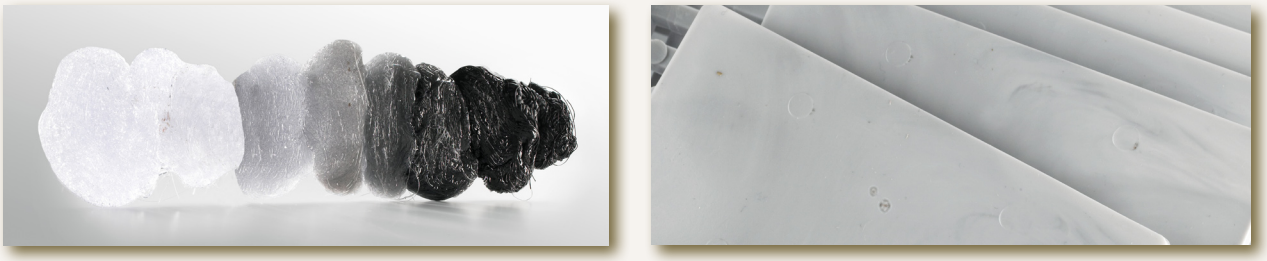
After purging with HDPE resin, the 20th part still showed signs of contamination, which was especially evident on the sprue. After purging with Dyna-Purge M, parts were contamination-free by the second part.

Trial 3: Black PC to White PC: 14 Melt

Processing Temperature: 530˚F (277˚C)

	Dyna-Purge M		PC Natural	
	Results	Total Cost	Results	Total Cost
Amount of product required (grams)	400	$2.20	1400	$5.45
Purging time (sec.)	103	$2.18	324	$6.86
Post-purging resin (grams)	61	$0.24	81	$0.32
Post-purge time (sec.)	9	$0.19	12	$0.25
No. of scrap parts	4	–	20+*	–
Time to good parts (sec.)	128	$2.71	640	$13.54
Weight of scrap parts (grams)	184.4	$0.72	930.8	$3.62
Total cost-to-purge		**$8.24**		**$30.04***

* NOTE: There was still contamination after 20 molded parts. Therefore, total cost-to-purge is more than $30.04.



After purging with 1,400 grams of PC, in-house resin appeared to be clean (left). However, when parts were molded they showed signs of streaking (right).

Trial 4: Black ABS to White ABS: 10 Melt

Processing Temperature: 480˚F (249˚C)

	Dyna-Purge M		ABS Natural	
	Results	Total Cost	Results	Total Cost
Amount of product required (grams)	300	$1.65	3250	$7.24
Purging time (sec.)	71	$1.50	710	$15.03
Post-purging resin (grams)	79	$0.18	81	$0.18
Post-purge time (sec.)	12	$0.25	13	$0.28
No. of scrap parts	14	–	20+*	–
Time to good parts (sec.)	448	$9.48	640	$13.54
Weight of scrap parts (grams)	662.1	$1.47	836.1	$1.86
Total cost-to-purge		**$14.53**		**$38.13***

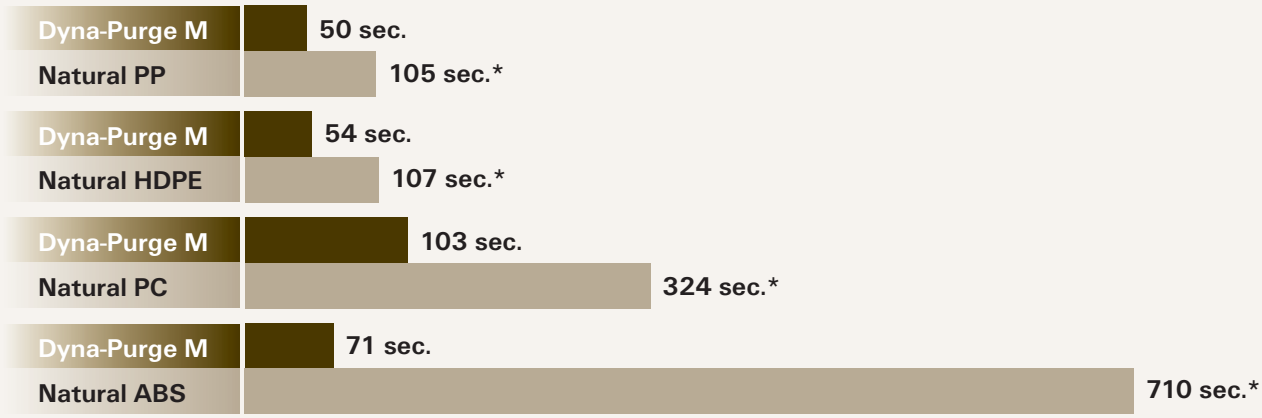
* NOTE: There was still contamination after 20 molded parts. Therefore, total cost-to-purge is more than $38.13.

It took 3,250 grams of ABS resin to purge vs. 300 grams of Dyna-Purge M.

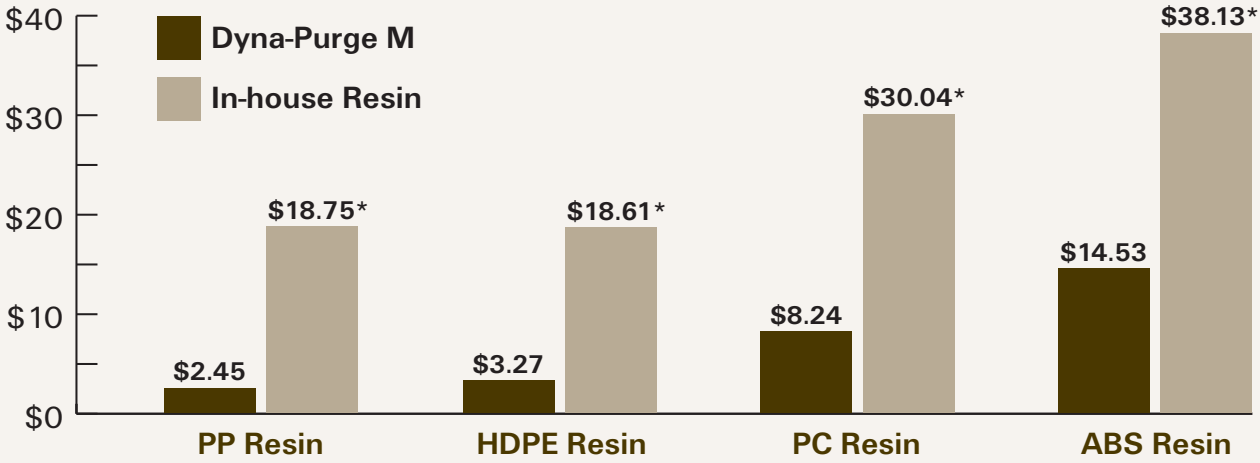
Summary of purging cost results

In each of the four trials, Dyna-Purge M ranked first in speed of purging and lowest cost-to-purge. The charts below show the results for each trial.

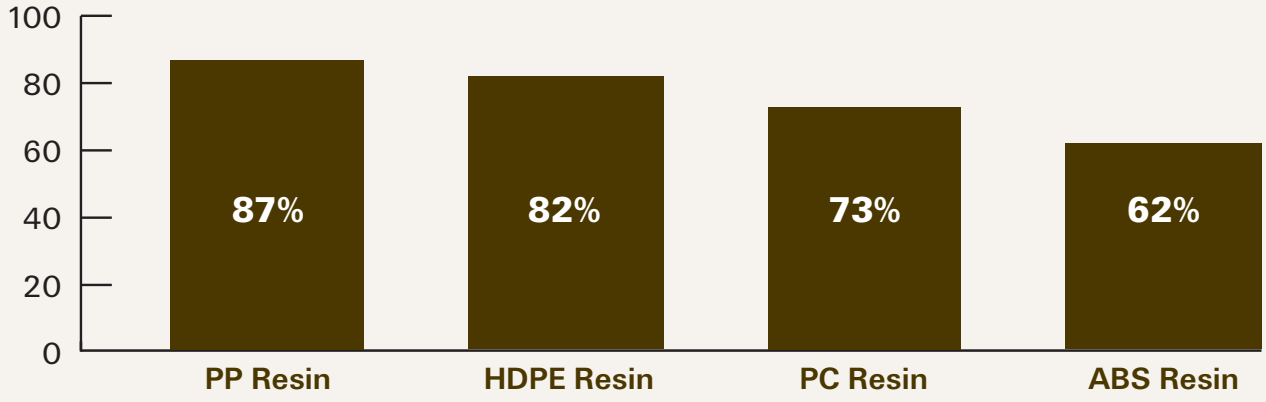
Time-to-purge comparison



Cost-to-purge comparison



Dyna-Purge M lowers purging costs by:



* NOTE: There was still contamination after 20 molded parts. Therefore, totals are more than the number stated.

Statement of Authentication

Diamond Polymers, Inc. verifies conformance to industry standards for testing protocol and the accuracy of the results reported.

Through its research and development capabilities, Diamond Polymers, Inc., a division of Network Polymers, provides comprehensive technical assistance including product design and development of thermoplastics. Both companies are certified to ISO 9001: 2000 quality standards.

The Diamond Polymers, Inc. laboratory holds A2LA accreditation from the American Association for Laboratory Accreditation for Mechanical Testing, covering specific tests and types of tests as agreed with the scope of accreditation. It meets the requirements of ISO/IEC 17025-1999 "General Requirements for the Competence of Calibrations and Testing Laboratories" (equivalent to relevant requirements of the ISO 9000 series of standards) and any additional program requirements in the identified field of testing.

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