



RCA Name Shutdown of plastics production line  
 Report Number 1.3  
 Report Date 3/15/2014  
 RCA Owner Edward Fitch

## Root Cause Analysis Report

### Problem Statement

**Focal Point** Shutdown of plastics production line

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#### When

Start Date 3/8/2014 End Date 3/11/2014  
 Start Time 0800 End Time 1530  
 Unique Timing Shutdown occurred during normal production run, 24-hour production schedule,

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#### Where

Site Plastics Business  
 Location Houston, TX  
 System Pellet Conveying  
 Component Blowers B-100 and B-200

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#### Actual Impact

		Cost
Environmental	20 lbs/day polystyrene vented to atmosphere	\$0.00
Revenue	Lost annual profit	\$60,000.00
Cost	Annual repair costs	\$30,000.00
<b>Actual Impact Total:</b>		<b>\$90,000.00</b>

Frequency 6 times per year

Frequency Notes 6th unplanned shutdown of the production line in last 12 months

#### Potential Impact

Revenue	Additional lost profit of extended downtime	\$60,000.00
Customer Service	Customer lost confidence in ability to provide material	\$0.00
Safety	Increased exposure to injury for service frequency of outages	\$0.00
<b>Potential Impact Total:</b>		<b>\$60,000.00</b>

# Report Summaries

## Executive Summary

Between 08-March-2014 and 11-March-2014, the plastics production line had to be shut down because of issues in the vacuum transfer system. The main blower stopped working when water, which had accumulated in the blower, tripped the circuit breaker. There is a backup blower system, however it would not start because the backup blowers were seized.

### Water in Primary Blower:

The conveyance system is a closed loop. The air in the system picked up water vapor from the 150 F water bath. The system was not designed with a knockout pot because at the time, Engineering did not foresee the need for one. Normally, excess water vapor is removed by the air dryer. However, it was not working properly because its condenser was plugged. Solids accumulate in the condenser and they were not being cleaned out. There is no PM scheduled for cleaning the condenser. Solids take the form of both accumulated polymer and pellets. The polymer is the result of residual monomer that is not being stripped out of the process. There is no monomer stripper because Engineering did not foresee the need. The pellets accumulate when the bag filters fail. Bag failures are caused by the fact that the bag material tore and is wrong (thin felt bags) for the current application. The tears were generated from sharp bag cage edges, and the differential pressure was causing the tears to grow larger, which was allowing small pellets to enter the system. The cage edges were sharp due to metal burrs not cleaned after a recent maintenance repair. These types of repairs are not common and are typically not performed as entire OEM cages are usually replaced in lieu of repairs. The repairs were necessary because the production line stoppage was causing extreme revenue loss and there were no immediate OEM cage replacements available.

### Backup Blower Unavailable:

The backup blowers were seized because the lobes and housing had rusted. These blowers are made from steel and they are exposed to the same wet circulating air as the primary blower system -- both are tied in to the main line. There are no isolation valves that would separate the blowers -- the need was not anticipated during the original design.

Solutions intended to prevent recurrence of the shutdown due to blowers tripping or rusting include:

- Adding quarterly condenser cleaning to CMMS PM system
- Installing a liquid level switch in front of the blowers
- Changing bagging material for pellets to Gor-tex so filler filters are not failing
- Updating engineering standards and specs to include RCA learning to better spec PM plans
- Performing design review of existing system to assure compatibility with current operating conditions and redesign as needed

## Cause and Effect Summary

The six shutdowns of the plastics production line over the last year have been caused by the loss of vacuum to operate the transfer system. The loss of vacuum is caused by the main blower tripping out on high amps and the back-up spare blowers not starting. The main blowers are tripping because they are filling with water, and the spares won't start because they seize due to rust. The main blowers are filling with water due to the water vapor present in the conveying air, because there is no knockout pot and it is a closed loop conveying system. The spare blowers are rusting because they are steel, they are exposed to air, and they also are filling with water. The discharge piping of the blowers tie together and there are no isolation valves. The water vapor is present because the pellets are being pulled into the airvey line after the water bath, the bath operates at 150 degrees F and the air dryer is not working. The dryer doesn't work because the condenser plugs frequently fill with solids because either polymer or pellets accumulate. The condenser is never cleaned because there was never a PM put in place to clean it. The pellets accumulated due to torn felt bag filters that allowed small pellets to enter the system. The torn bags were caused from sharp cage edges left from prior maintenance repairs. The maintenance team was unaware of the need to debur the edges after repair. These uncommon cage repairs were required because OEM replacement cages were not available. The polymer accumulates

because the residual monomer present polymerizes. The monomer is present because of the unreacted monomer in the pellets is not stripped out because there is no stripping system. The lack of a stripper, lack of a knockout pot, and lack of a PM to clean the condenser were caused by the engineering team not anticipating the need for these things.

## Solutions

<b>ID</b>	<b>Label</b>	<b>Description</b>		
1	<b>Solution</b>	Update engineering standards and specs to reflect the RCA learnings		
	<b>Cause</b>	Engineering didn't anticipate need		
	<b>Note</b>	Opportunity to included best practices and better spec preventive maintenance plans. Solution does not prevent recurrence of focal point, but is a value-added solution that will help enhance the preventive maintenance program.		
	<b>Assigned</b>	Jason Dufner	<b>Criteria</b>	Fail
	<b>Due</b>	3/23/2014	<b>Status</b>	Selected
	<b>Term</b>	Long	<b>Cost</b>	\$1,000.00
2	<b>Solution</b>	Change bag material to Gore-tex		
	<b>Cause</b>	Thin felt bags being used		
	<b>Note</b>	Existing material in not sufficient. Gore-tex has been evaluated and is the best viable substitute.		
	<b>Assigned</b>	Hale Irwin	<b>Criteria</b>	Pass
	<b>Due</b>	3/27/2014	<b>Status</b>	Approved
	<b>Term</b>	Long	<b>Cost</b>	\$2,000.00
3	<b>Solution</b>	Install vacuum jets to strip and recover monomer.		
	<b>Cause</b>	No monomer stripper in system		
	<b>Note</b>	Solution is intended to aid in keeping condenser from plugging.		
	<b>Assigned</b>	Hale Irwin	<b>Criteria</b>	Pass
	<b>Due</b>	4/13/2014	<b>Status</b>	Identified
	<b>Term</b>	Long	<b>Cost</b>	\$5,000.00
4	<b>Solution</b>	Add quarterly condenser inspection/cleaning to CMMS PM system.		
	<b>Cause</b>	No PM for cleaning condenser		
	<b>Note</b>	Criticality of condenser maintenance was unknown prior to this analysis.		
	<b>Assigned</b>	Ryan Moore	<b>Criteria</b>	Pass
	<b>Due</b>	3/16/2014	<b>Status</b>	Approved
	<b>Term</b>	Medium	<b>Cost</b>	\$0.00
5	<b>Solution</b>	Install liquid level switch at low spot in piping in front blowers.		

<b>Cause</b>	Water accumulated in blower		
<b>Note</b>	Solution will aid in understanding if liquid is settling in or near blowers.		
<b>Assigned</b>	Hale Irwin	<b>Criteria</b>	Pass
<b>Due</b>	4/13/2014	<b>Status</b>	Approved
<b>Term</b>	Long	<b>Cost</b>	\$2,500.00

6	<b>Solution</b>	Perform design review of existing system to assure compatability with current operating conditions and redesign as needed.	
	<b>Cause</b>	Equipment not updated for new operating conditions	
	<b>Note</b>		
	<b>Assigned</b>	Jason Dufner	<b>Criteria</b> Pass
	<b>Due</b>	3/16/2014	<b>Status</b> Identified
	<b>Term</b>	Long	<b>Cost</b> \$1,000.00

## Team

ID	Label	Description	Label	Description
1	<b>First Name</b>	Ryan	<b>Last Name</b>	Moore
	<b>Phone (1)</b>	800-500-7000	<b>Phone (2)</b>	
	<b>Role</b>	In-House Production Manager	<b>Group</b>	PlasticCompany, Inc.
	<b>Email</b>	rmoore@plastics.inc.com		
2	<b>First Name</b>	Jason	<b>Last Name</b>	Dufner
	<b>Phone (1)</b>	800-500-7001	<b>Phone (2)</b>	
	<b>Role</b>	Production Supervisor	<b>Group</b>	PlasticCompany, Inc.
	<b>Email</b>	jdufner@plastics.inc.com		
3	<b>First Name</b>	Hunter	<b>Last Name</b>	Mahan
	<b>Phone (1)</b>	800-500-7002	<b>Phone (2)</b>	
	<b>Role</b>	Sologic Facilitator	<b>Group</b>	PlasticCompany, Inc.
	<b>Email</b>	hmahan@plastics.inc.com		
4	<b>First Name</b>	Dustin	<b>Last Name</b>	Johnson
	<b>Phone (1)</b>	877-777-7777	<b>Phone (2)</b>	
	<b>Role</b>	Blower Pump Product Developer	<b>Group</b>	BlowerMotors, Inc.
	<b>Email</b>	dustin.johnson@blower.motors.com		
5	<b>First Name</b>	Hale	<b>Last Name</b>	Irwin
	<b>Phone (1)</b>	800-500-7003	<b>Phone (2)</b>	
	<b>Role</b>	Maintenance Supervisor	<b>Group</b>	PlasticCompany, Inc.
	<b>Email</b>	hirwin@plastics.inc.com		

## Evidence

ID	Label	Description
1	<b>Evidence</b> <b>Cause(s)</b>	<p>Team Member Observation</p> <p>Pellets transferred by vacuum conveying</p> <p>Loss of vacuum to transfer pellets</p> <p>Main blower circuit breaker tripped on high amps</p> <p>Water accumulated in blower</p> <p>No knockout pot</p> <p>Water vapor in conveying air</p> <p>Condenser plugged</p> <p>Solids accumulate</p> <p>Polymer accumulates</p> <p>No monomer stripper in system</p> <p>Monomer polymerizes</p> <p>Pellets accumulate</p> <p>Bag filters tear</p> <p>Water bath at 150 degrees F</p> <p>Air circulates in closed loop system</p> <p>Blowers seized</p> <p>Lobes/housing rusted</p> <p>Blowers exposed to air</p> <p>Both blowers tied in to main line</p> <p>No isolation valves to separate blowers</p> <p>Rust eliminates clearances</p> <p>Circuit breaker protects motor</p> <p>Pellets small enough to pass through tear</p> <p>Cage repair not common</p> <p>Usually replace cages with OEM replacements</p> <p>Replacement cages unavailable</p> <p>Could not tolerate downtime</p> <p>We don't stock spares internally</p> <p>Company direction to reduce in-house spare parts</p> <p>Product sold out</p> <p>High margin product</p> <p>Cages have some sharp edges</p> <p>Cages not designed to handle current operating conditions</p> <p>Operating conditions different than original design</p> <p>Equipment not updated for new operating conditions</p>
	<b>Location</b>	
	<b>Link</b>	
	<b>Contributor</b>	Jason Dufner
	<b>Type</b>	Direct Observation

**Quality**

2	<b>Evidence</b>	Written Document (blower design/usage documents)
	<b>Cause(s)</b>	Design didn't include knockout pot No PM for cleaning condenser Residual monomer present Steel blowers Cages previously repaired in-house Replacement cages unavailable High differential pressure across bags Cages not designed to handle current operating conditions
	<b>Location</b>	
	<b>Link</b>	
	<b>Contributor</b>	Ryan Moore
	<b>Type</b>	Document
	<b>Quality</b>	★★★★★

3	<b>Evidence</b>	Verbal Statement
	<b>Cause(s)</b>	Engineering didn't anticipate need Air dryer not working Condenser not cleaned Gap in Mtc/Eng procedures Monomer not stripped from process Thin felt bags being used Back-up blower won't start Start-up attempted Previous repairs not deburred Maintenance did not think about deburring Usually replace cages with OEM replacements Cages collapsed Could not tolerate downtime Vendor no longer stocks replacement cages We don't stock spares internally Company direction to reduce in-house spare parts High margin product Cages have some sharp edges Operating conditions different than original design
	<b>Location</b>	
	<b>Link</b>	
	<b>Contributor</b>	Hale Irwin



**Type** Direct Statement  
**Quality** ★★☆☆☆

