Dr. Die Cast

Plant Engineering: What's Love Got To Do With It?
(Horseless carriages or total integration)

With apologies to Tina Turner for paraphrasing one her classic songs, "what's (Plant Engineering) got to do with (die casting process) it?" Everything!

The early automobiles were referred to as "Horseless carriages" and in fact they were simply that, a horse drawn carriage with a few parts removed and replaced with an engine and a mechanism to steer and stop. Today's automobiles are primarily "uni-body" short for unitized or unit body construction. Every component has a purpose and works together to create the vehicles we see every day. Which version does your factory resemble? Is it the result of a not so effective adaptation from a former use or one of a totally engineered facility, from design, to integration and optimization?

Let's start with a scenario. Probably your company started with a certain number of machines in the corner of a leased building. The concrete floors were thin and worn and the ceilings were low. Ventilation was achieved by opening doors and windows. Water cooling for the machinery was achieved by hooking up to a deep well or city water or worse yet from a nearby stream. You rented the largest compressor you could find and went in to business. The process was "cheap and dirty", i.e. manual die spray, manual extract, and even the tip lube was applied with a brush. The operator safety door was even opened and closed manually. As business (and profits) improved you invested in automation, first with "fixed head sprayers", a tip lube system and even an air cylinder operated safety door. Eventually you added more and/or larger die casting machines and reciprocating die sprayers with multiple spray heads. All these improvements increased the number of total shots per hour and the demand on the melting furnace(s). Eventually and inevitably you ran out of some essential utility. Shortages of electric capacity are easy to identify, when you blow a fuse or circuit breaker, it's pretty clear you overloaded the circuit and need to upgrade your electrical system. But how do you pinpoint a shortage of compressed air, central die lube, process cooling water or central melt?

Compressed Air and Central Lube

One die spray manifold with 8 dual facing spray heads is equivalent to 16 operators with a manual spray gun spraying simultaneously! Multiply this by the number of machines in your shop and the demand on your central die lube and compressed air system can catch you unprepared. One die cast plant found that installing custom spray manifolds cut their cycle time by 1/3. Each manifold they installed was like getting a third die casting machine for free! However when they outran their compressed air system all of the machines suffered. In addition, as the shots per hour increased the demand on the cooling tower system and melt system increased proportionally.

Figure 1 *- A Chart recorder was connected to a main line. The line was supposed to be 110 +/- 2 PSI.*

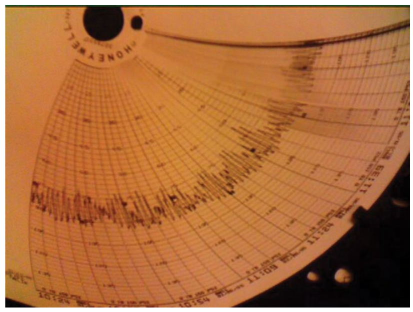

Figure 2 *- Variations of 30 PSI were recorded. This is a main line feeding 7 machines. The line from the compressor was 3 sizes smaller than the manifold.*

One mistake that people make is to look at their average (scheduled) production as a final step to calculate their (theoretical) infrastructure demand. The fallacy with this approach is that only supporting the average schedule becomes the limiting factor. My production capacity will be

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limited in the name of energy or capital conservation. However, you need to size for peak demands with extra capacity for the inevitable inefficiencies. This may seem like a waste of energy but we are talking about capacity. For example consider this. If my compressed air distribution system (plumbing and routing) is undersized, I will have to operate my compressor at peak output in order to "force" air to the end of the line. A properly sized and configured air-line will deliver air with the least frictional losses. In some cases a simple completion of a "closed loop" air system is enough to reduce or eliminate a significant bottle-neck. Quite often these can be added with little or no interruption of production.

Air Pressure Drop Example

Let's assume we have a 2" NPT line at 100 PSI at the compressor and the run is 300 feet.

The load is eight 600 ton machines with 8 spray heads. Peak demand is 4.2 CFM/nozzle (2nozzles/head) X 8 heads per machine X 8 machines = 537 CFM.

With the 2" NPT line, the pressure drop will be 7 PSI leaving a usable pressure of 93 PSI.

This is not ideal but safe since the critical factor is for the air pressure to be greater than the lube pressure in order to achieve atomization.

Interestingly, increasing the line size from 2 to 2 ½" NPT yields almost no improvement. However increasing from 2 to 3" NPT reduces the pressure drop to 1 PSI while increasing from 2" to a 4" NPT line would reduce the pressure drop to 0.2 PSI.

Typical compressor outputs are 4 to 5 CFM/HP. For this example, a 120 HP compressor at full-load would be required. A properly sized receiver will help smooth out the demand.

Summary

By documenting system demands and identifying and eliminating bottlenecks we are able to improve the productivity in the plant.

The benefits of reducing variation at all levels in the factory makes higher quality levels possible.

Look for additional details on the rest of the systems in future editions.