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CONSULTING FOR THE PLASTICS INDUSTRY

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PCS CORPORATION – CHINA

Report

Observations, Recommendations And Summary

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Executive Summary

Consultek has been retained to review PCS operation in China. The following items of interest were reviewed from technical viewpoint:

Overall manufacturing operation
Equipment and tooling condition
Molding Practices
Critical needs
Key personnel competency and expertise
Expected changes and improvement
Miscellaneous observations

Overall impression of PCS-CHINA operation is positive. Positive in terms of key personnel competency and expertise, plant layout, room for expansion, opportunities for improvement, labor cost reduction through automation, warehouse set-up, building condition, and limited quality issues. There are several areas of concern that need immediate attention:

1. Molding Practices
2. Processing Equipment
3. Material handling
4. Preventive Maintenance
5. Personnel Education and Training
6. Tooling

By addressing these issues, improved efficiency, higher throughput and labor cost reduction benefits can be realized in a short period.

Injection molding equipment appears to be in good condition. If properly maintained, useful service life of five to seven years can be expected. Preventive maintenance is lacking on all the machines. Tooling maintenance is adequate but needs improvement in the area of record keeping, systematic tool cleaning procedures, traceability, and well defined tooling preventive maintenance program. Some other areas of concern are safety, material handling system, material drying system, inadequate water circulation system, regrind management, automation and aging auxiliary equipment.

In summary, the basic infrastructure for manufacturing products is in place; however, opportunities exist and there is lots room for improvement via automation, equipment upgrade and modernization.

Ratings Summary

	PCS
Overall	4
Equipment: Injection Molding	5
Tooling: Injection Molding	7
Tool Maintenance	5
Tool Room	7
Key personnel competency and expertise	5
Auxiliary equipment: Injection Molding	3
PM program	1
Safety	5
Automation	4
Material handling system	4
Warehouse	5
Production Monitoring system	Manual
Quality assurance	7
Technology	5

Ratings: On a scale of 1 to 10 with 10 being the best based on consultant's experience and knowledge of the industry and molding operations.

Material Handling

Dryers

All dryers used are **HOT AIR** type dryers. Engineering materials such as PBT, NYLON, PC/ABS requires the use of **DEHUMIDIFYING** type dryers. This is important if you are to make dimensionally consistent and strong (Less brittle) parts.

EFFECT of MOISTURE on FINISHED PARTS

Improperly dried resin can cause a variety of defects in a part during processing, such as:

- Splay/Silver Streaks
- Bubbles/Voids
- Brittleness
- Burning

Experience has shown that more than 75% of processing problems are related to moisture and improper drying. Moisture present during processing can also seriously degrade the polymer, especially if it is hygroscopic like PBT Polyester, nylons etc. *Drying of resin using a desiccant dehumidifying hopper dryer is essential for moisture removal.*

Effect of drying time on moisture content

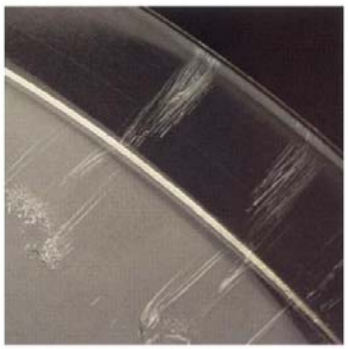
Resin after drying 1 hour *Resin after drying 2 hours* *Resin after drying 3 hours*

Recommended minimum drying time: 4 hours

Examples of Moisture Induced Defects

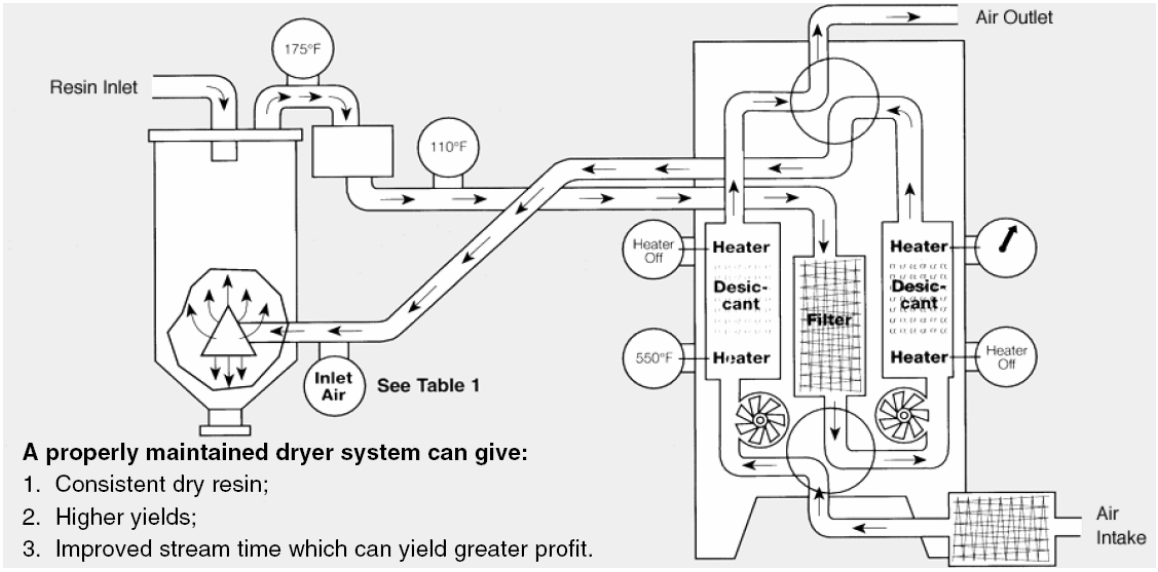
Moisture Bubbles

Burning



Splay

Dehumidifying Dryer



A properly maintained dryer system can give:

1. Consistent dry resin;
2. Higher yields;
3. Improved stream time which can yield greater profit.

Source: Bayer

Material Storage

Material is left open to atmosphere in bags to absorb moisture and contamination. They need to be stored in drums with lids and labels.

Material Storage (FRE)

Color blending on the injection line is handled by tumbler mixers. All material is set up to be delivered to the injection molding machines via vacuum loaders from gaylords or barrels. However, we did not see this system in operation.

Granulators

Granulator blades are completely worn out. We suspect all of them are like the one we inspected. They grind/crush and not cut creating lots of dust and uneven chunks. Also the granulator screens (holes) are too large allowing entire sprues to pass thru ungrounded.

Material Grinding at FRE

Issues With regrind

- Loss of properties
- Depletion of additives
- Fines, dust, contamination
- Processibility issues
- Feeding issues
- Tracking exact level of regrind in a part
- Greater level of moisture pick-up

Solution

- Proper Calibration of blender & Mixing
- Drum tumbling and mixing
- Proper grinder screen size
- Sharp grinder blades
- Fine separators
- Hot runner molds
- Proper runner sizing (Parts/Runner ratio)
- Automation – closed loop feed back

Regrind management

Methods of Regrind Use

Today there are multiple schools of thought on how regrind should be handled. The one that has been around for quite some time and published by many material suppliers is a 75% virgin to 25% regrind blend. This works reasonably well provided the regrind is uniform in pellet configuration, not contaminated or degraded, and blended properly. This method is routinely practiced by many molders across the country.

We were not able to ascertain if only recommended 25 % of the regrind is properly mixed and fed back in the system. Looking at the part to sprue/runner ration, one would expect more than 25 percent regrind is being generated. A comprehensive study of each part to sprue/runner ratio needs to be done to determine the current status.

Processing Equipment

- Molding machines are too large (Shot size) for the size of parts made. This opens doors to material degradation and other quality issues.
- Machines do not have a good way of monitoring important parameter such as pressure
- Mold temperature is not regulated with the use of mold temperature controller/regulators. This is essential for molding engineering thermoplastics.
- Machines do not hold cushion indicating worn out check ring and/or screw and barrel.
- Majority of the machine nozzle orifice appears to be small. Small orifice tend to create a large pressure loss.

Water Management and Water System

The water system is inadequate and poorly designed. There should be a differential diameter difference of approximately 2" between the supply and return lines; the return lines being the larger diameter. The machine mounted water manifolds along with the size of the water lines are too small for adequate cooling. We suspect that the size of the water tower is too small for the number of machines in the plant. Except for molding LCP it is not necessary to use oil circulating temperature controller (Thermolaters) for the mold temperature regulation. Water circulating units are much more efficient, safe and adequate for majority of parts molded in this plant. Water should be chemically treated on regular basis to keep solids (PPM) under control to allow waterlines in the mold and the machine heat exchanger from getting clogged up.

Molding Practices

- Most of the machines are set to Inject (Fill) and recover for next shot instead of the correct way to mold, Inject – Pack and Hold – Recover
- Multi-Eject practice of ejecting parts is hard on molds and machines. No more than two strokes should ever be required.
- Material temperature settings appear too high.

Preventive Maintenance

- Machines are not maintained
- Most screws, barrels and check ring appears worn out. No cushion is maintained to allow pack and hold
- Preventive maintenance program is sorely lacking

- Water lines are too small
- No water maintenance program

Documentation:

No written documentation appears to be available of any maintenance procedures on equipment for the plant. Also, historical records for the maintenance of any equipment are not maintained. There is no system for determination of real time production output. No master process sheets were seen for the set up of the injection molds. We recommend investigating commercial Preventive Maintenance Software programs that are specifically designed for injection molding operation.

Personnel Education and Training

- Personnel appear to have good attitude and eager to learn. Molding knowledge is very shallow. Systematic on-the-floor training and education program is needed.
- Our experience is that one time training on molding practice is not enough. It needs continuous reinforcement to be effective

Tooling

- Many molds are without water. It is imperative that Mold (Steel) temperature is maintained to recommended settings to make consistent parts
- Sprues, runner sizes and venting is inadequate in most molds.

Due to the nature of the business, namely short runs, some type of Master Unit Die system should be looked at so that the inserts can be removed from the front of the molds without having to send the molds back to the tool room. This system should reduce change over time and improve overall efficiency.

Cycle counters should be installed on all high volume production molds.

Recommendations

The following recommendations are listed in the order of importance starting with the most critical matters needing urgent attention.

Personnel training:

We recommend hands-on (At-the-press) training and demonstration. The intent is to educate technicians about the proper way to set-up and start-up the machine, optimize the process, crating universal set-up sheet, and troubleshoot. The training will take approximately two to three days.

Process Set-up

The practice of Inject (Fill) and recover must be changed to Inject – Pack & Hold – Recover to mold consistent parts and improve efficiency.

Drying

As discussed earlier, materials must be dried using dehumidifying dryers. There are many options to consider ranging from conventional desiccant types to newly developed honeycomb rotary bed types.

Equipment Maintenance

A comprehensive program to evaluate the condition of the check ring assembly, screw and barrel must be set up. This may be the reason for not being able to pack out parts and get consistency.

Regrind Management

Granulator conditions, grinding practices and regrind management (part to sprue/runner ratio) need to be addressed. If the purchase of new granulator in near future is budgeted, we highly recommend low speed, staggered blade type granulators. They cut more efficiently and create very little fines.

Tooling

A systematic approach to evaluating the tools at the end of the production run is necessary to minimize chronic problems and improve productivity. This will also require hands-on training with tooling personnel.

In order to minimize the regrind, improve cycle time and automate, the hot runner technology should be evaluated. We suggest selecting a high volume product and get us involved from the inception of the project so that we can contribute starting from product design, tool design and selection of appropriate hot runner system, tool building, process set-up and optimization. We believe that this approach will improve efficiency and reduce overall cost of the product.

Basic Tools

We recommend investing in basic injection molding tools such as needle pyrometer to check melt temperature, IR pyrometer to check mold temperature, accurate gram scale to conduct gate freeze study, digital flow meter to check flow rate of the water and dew point meter to check dryers drying efficiency.

General Observations

During our visit, we saw lots of opportunities for automation and efficiency improvement in reel to reel molding area.