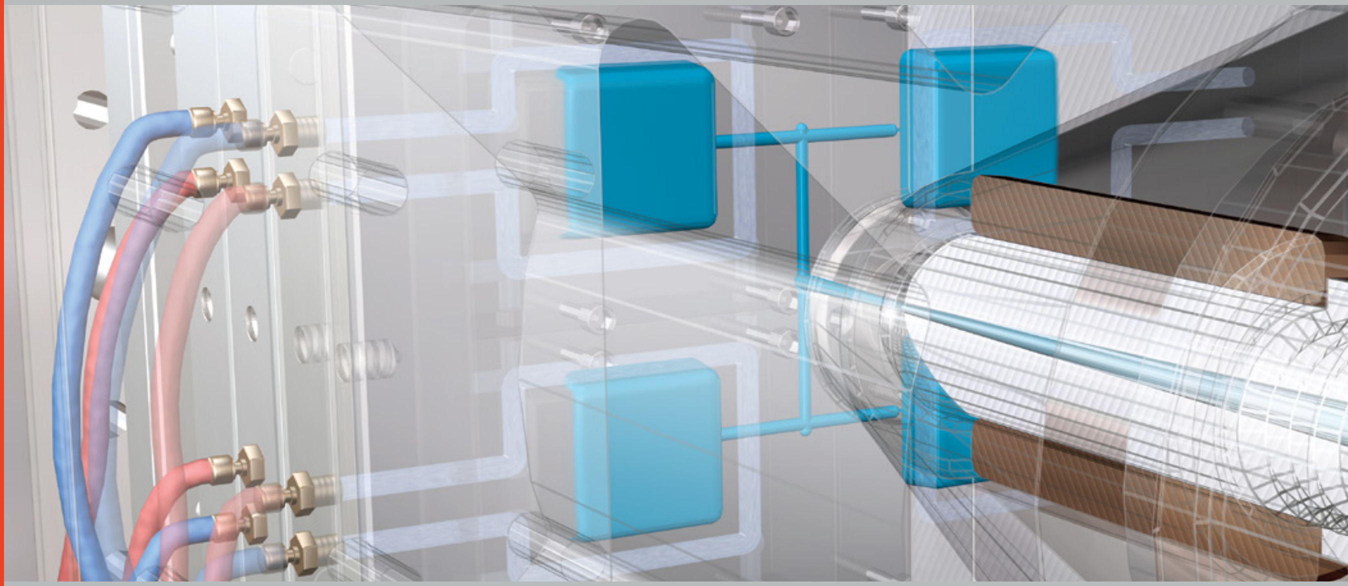
REFERENCE SERIES: PROCESSING

Understanding Scientific Process Documentation



nexeo plastics

Created exclusively for **Nexeo Plastics** by Routsis Training, this free guide contains excerpts from Routsis's ***Scientific Molding Courses***.

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PROCESS DOCUMENTATION

There are several different appoaches to process documentation: Machine Dependent, Machine Independent, and Hybrid Documentation.

In practice, process documentation needs to be collected for both the machine and the process.

Machine Dependent Process Documentation

Machine-specific clamp and ejection settings are needed and may be saved into the machine's computer system.

Machine-dependent parameters are based on process inputs and are specific to each molding machine. These parameters will not transfer directly from one machine to another even if the machine specifications are identical.

Examples of machine-dependent parameters include:

- Barrel Temperature
- Injection Velocity
- Transfer Velocity
- Transfer Position
- Clamp Tonnage

Advantages

The main advantage of using machine-dependent documentation is that it provides data which can be directly entered into the molding machine — typically allowing the setup technician to get the process up and running more quickly; and to spend less time documenting the process.

Machine Dependent Process Setup Sheet

Machine #	14
Mold #	640
# of Cavities	4
Material Type	PC
Material Grade	LS456
Technician	J. MOLDER
Date	2/3/2021

Barrel & Recovery

Zone 1	300	°C
Zone 2	305	°C
Zone 3	310	°C
Zone 4	315	°C
Nozzle	320	°C
Screw Speed	45	RPM

1st Stage Injection

Shot Size	250	mm
Velocity 1	100	mm/s
Position 1	200	mm
Velocity 2	100	mm/s
Position 2	150	mm
Velocity 3	100	mm/s
Transfer	50	mm
Maximum Pressure	1000	bar

2nd Stage Packing

Packing Pressure	400	bar
Packing Time	2.00	s

Mold Clamping

Clamping Force	210	tons
Cycle Time	13.02	s
Clamp Type	TOGGLE	

Part Cooling

Cooling Time	6	s
Core Setpoint	80	°C
Cavity Setpoint	80	°C

Disadvantages

The disadvantages of using machine-dependent documentation during mold setup are that the process inputs are replicated from a past run on a particular machine. These parameters cannot be used on a different molding machine – not even on machines with identical specifications.

Machine-dependent documentation does not provide process output data, makes process troubleshooting very difficult, and does not compensate for changes in lot-to-lot material variation.

Machine Independent Process Documentation

Machine-independent parameters are based on process outputs from a good molding process. Many machine-independent parameters are identical to the process inputs, such as Packing Time and Clamp Tonnage.

All machine-independent parameters facilitate a process to be easily transferred from one molding machine to another. Using such parameters is ideal for companies who run a mold in multiple machines.

Examples of machine-independent parameters include:

- Melt Temperature
- 1st Stage Fill Time
- 1st Stage Fill-only Part Weight
- 2nd Stage Pressure Applied to the Plastic
- 2nd Stage Packing Time
- Final Part Weight

Machine Independent Process Setup Sheet

Machine #	14
Mold #	640
# of Cavities	4
Material Type	PC
Material Grade	LS456
Technician	J. MOLDER
Date	2/3/2021

Barrel & Recovery

Melt Temp	305	°C
Recovery Time	4.76	s
Back Pressure	25	bar

1st Stage Injection

Fill Time	2.05	s
1st Stage Weight	110.7	grams
Transfer Pressure	642	bar

2nd Stage Packing

Packing Pressure	400	bar
Packing Time	2.00	s
Gate Seal Time	1.7 – 1.8	s
Final Part Weight	123.41	grams

Mold Clamping

Clamping Force	210	tons
Cycle Time	13.02	s
Clamp Type	TOGGLE	

Part Cooling

Cooling Time	6	s
Core Coolant IN	78	°C
Core Coolant OUT	80	°C
Core Flow	9.5	l/min
Cavity Coolant IN	80	°C
Cavity Coolant OUT	82	°C
Cavity Flow	9.5	l/min

Advantages

Using machine-independent documentation during mold setup provides significant advantages: The data provided is based on process outputs — allowing the process to be transferred to different molding machines.

Process troubleshooting is also simplified by clearly identifying the resultant process. In addition, the process is developed independent of variations in the plastic material.

Disadvantages

The disadvantages of using machine-independent documentation during mold setup are that more processing knowledge is required, more effort is required to implement, and more time is needed to properly document.

Hybrid Process Documentation

Some molders use a hybrid form of process documentation that combines both machine-dependent and machine-independent parameters. The machine-dependent documentation is used for reference during setup, while the machine-independent documentation is used once the machine is started.

The hybrid approach can be confusing — as machine inputs will provide different outputs each time they are used. For example, a 300°C degree Barrel Temperature may result in a 305°C Melt Temperature in one instance and 285°C in another.

Be sure to clarify which parameters are more important. For instance, both the Barrel Temperatures and the Melt Temperature may be provided. In this case, the machine independent Melt Temperature should be highlighted to identify that it is more important.

By identifying the more important parameter, the die setter will know that the Barrel Temperatures should be adjusted in order to achieve the desired Melt Temperature. This also applies to the 1st Stage Fill Time and Injection Velocity parameters.

Hybrid Process Setup Sheet

Machine #	14
Mold #	640
# of Cavities	4
Material Type	PC
Material Grade	L5456
Technician	J. MOLDER
Date	2/3/2021

Barrel & Recovery

Zone 1	300	°C
Zone 2	305	°C
Zone 3	310	°C
Zone 4	315	°C
Nozzle	320	°C
Melt Temp	305	°C
Screw Speed	45	RPM
Recovery Time	4.76	s
Back Pressure	25	bar

1st Stage Injection

Shot Size	250	mm
Velocity 1	100	mm/s
Position 1	200	mm
Velocity 2	100	mm/s
Position 2	150	mm
Velocity 3	100	mm/s
Transfer	50	mm
Maximum Pressure	1000	bar
Fill Time	2.05	s
1st Stage Weight	110.7	grams
Transfer Pressure	642	bar

2nd Stage Packing

Packing Pressure	400	bar
Packing Time	2.00	s
Gate Seal Time	1.7 – 1.8	s
Final Part Weight	123.41	grams

Mold Clamping

Clamping Force	210	tons
Cycle Time	13.02	s
Clamp Type	TOGGLE	

Part Cooling

Cooling Time	6	s
Core Setpoint	80	°C
Core Coolant IN	78	°C
Core Coolant OUT	80	°C
Core Flow	9.5	l/min
Cavity Setpoint	80	°C
Cavity Coolant IN	80	°C
Cavity Coolant OUT	82	°C
Cavity Flow	9.5	l/min

Advantages

There are several advantages to using a hybrid form of process documentation. Doing so provides specific data to enter into the machine, given that the process has been run previously on that particular machine — and machine-independent data, which is helpful if the mold has not been run on that particular machine.

The hybrid approach also provides the molder with all the information necessary to properly troubleshoot the process.

Disadvantages

A clear disadvantage of using a hybrid form of process documentation is that it takes more time to document both sets of parameters. Furthermore, it can become quite confusing if the intent and proper use of this information is not well understood by all the technicians.

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