How to select Plastic Injection Moulding Machine 10

Contributed by Administrator
Sunday, 30 September 2007
Last Updated Sunday, 30 September 2007

4.4 Reliability

Tiebar breakage, platen breakage or toggle failure are catastrophic as their replacement is usually beyond the means of a moulder. Reliability could be measured by mean time between failure (MTBF). It could also be measured by availability which is the percentage of the machine up time. Both could only be measured by the user over a number of years of use. Nevertheless, it could be the most important non-quantifiable attributes of all.

5. Unit conversion

When comparing PIMMs from Europe, Japan and the USA, one needs to convert among the various systems used in the specifications. The SI system is the preferred one.

5.1 The SI system

The SI system is used by European manufacturers. It is a metric system, distinguished by the use of Newton for force, and bar for pressure.

5.2 The Metric system

The Metric system is used by Japan and Far Eastern manufacturers. It is a metric system using gravitational kg (kgf to be exact) for force and kg/cm2 (kgf/cm2 to be exact) for pressure. One tonne is one thousand kg.

5.3 The Imperial system

The Imperial system is used by USA manufacturers. It is not a metric system. It is characterized by the use of oz (ounce) for shot weight, in (inch) for dimension and stroke, in3 for injection volume, gal (gallon) for oil tank capacity, lb. (pound) for force and hopper capacity, psi (pound per square inch) for pressure, kW for heating capacity, hp (horse power) for electric motor power and oF (Fahrenheit) for temperature. One oz is one sixteenth of a pound, one (short) ton is 2000 lb. SIMetricImperialDimension, strokemm, mmm, minInjection volume cm3cm3in3Capacityl (litre)l (litre)in3, galWeightg, kgg, kgoz, lb.oz, lb.N, kNkg, t (tonne)lb., (short) tonTorqueNmkg-min-lb.Pressurebar, kbarkg/cm2psiPowerW, kWW, kWkW, hpTemperatureoCoCoFTable 8. Three common measurement systems

5.4 Unit conversion

The conversion between SI system and Metric system is related to the gravitational constant. The approximation listed below are commonly used.

1 N = 1/9.807 kg = 0.102 kg ~= 1/10 kg
1 kN = 1/9.807 tonne = 0.102 tonne ~= 1/10 tonne
1 Nm = 1/9.807 kg-m = 0.102 kg-m ~= 1/10 kg-m
1 bar = 1.020 kg/cm2 ~= 1 kg/cm2

1 kg = 9.807 N ~= 10 N
1 tonne = 9.807 kN ~= 10 kN
1 Mp = 1/10 kN
1 kg-m = 9.807 Nm ~= 10 Nm
1 kg/cm2 = 0.9807 bar ~= 1 bar
Occasionally, Pa (Pascal) or MPa is used. 1 MPa = 10 bar.

1 in = 25.4 mm
1 in3 = 16.4 cm3 = 0.0164 litre
1 gal = 3.785 litre
1 oz = 28.4 g
1 lb. = 0.454 kg = 4.448 N
1 (short) ton = 0.908 tonne
1 in-lb. = 0.01153 kg-m = 0.1131 N-m
1 psi = 0.07031 kg/cm2 = 0.06895 bar
1 hp = 0.7457 kW

1 g = 0.0352 oz
1 kW = 1.341 hp
1 kg/cm2 = 14.22 psi
1 bar = 14.5 psi

oF = oC * 9/5 + 32
oC = (oF - 32) * 5/9

6. Some mistakes

Some mistakes moulders have made selecting PIMMs are listed below.

6.1 Incorrect shot weight

Is an ounce of gold heavier than an ounce of cotton? The answer to this trick question is very often incorrect. (The correct answer is no.)

Many a moulder who selects PIMM by shot weight alone often thinks an ounce of PP is the same as an ounce of PS, which is not the case.

The injection unit of a PIMM has an injection volume which is constant irrespective of the type of material used. The shot weight of a PIMM is roughly the weight of PS in this injection volume, which is different than the weight of PP in the same volume. Eight ounces of PS in the shot volume is only 6.6 ounces of PP in the same volume. Selecting an 8-ounce machine would not be adequate for moulding 8 ounces of PP. See Example 2 in Section 2.1.2.

'Experienced' moulders take care of such discrepancies by oversizing a PIMM, which is inaccurate and could be wasteful in investment and in the energy cost running it.

6.2 Wrong screw selected

A moulder is moulding ABS articles with a total weight of 4.5 oz. In order to be sure, he specified a 'more powerful' machine with shot weight of 9 oz. During moulding, it was discovered that there was excessive shrinkage.

A portion of the machine specification is shown in Table 9. ScrewABCScrew diameter (mm)353943L/D ratio222018Injection volume (cc)173215261Shot weight (PS) (g)145181220Shot weight (PS) (oz)5.579Injection pressure (kg/cm2)156912641039Table 9. Machine with three screws

What the moulder should have selected is screw A with a shot weight of 5.5 oz since injection pressure is high. To be 'safe', screw C was selected which has a shot weight of 9 oz, but has a lower injection pressure. The low injection pressure caused the excessive shrinkage.

The moulder was correct in that a more powerful selection puts him on the safe side. However, a higher shot weight is not more powerful; a smaller screw diameter giving an adequate shot weight but higher injection pressure is what should be considered more powerful.

6.3 Mould height neglected

A moulder has only considered the space between tiebars and has found a certain model of PIMM could accommodate his mould. When installing the mould, it was then discovered that the mould was too high for the machine. It often helps to send the mould to the manufacturer to mount it before a decision is made.

6.4 Mould mounting holes too far apart

A moulder sent his mould to the manufacturer to do test shots. Then it was discovered the mould mounting holes are too far apart for the mould. A smaller machine was selected, which did the job and saved the moulder a bunch.

6.5 Wrong interpretation of electric motor rating

A moulder finds the higher wattage electric motor in a PIMM of one brand 'uses up more energy' than a lower wattage one of another brand. A higher wattage by itself does not use up more energy. Rather, the overload to the motor is reduced. A misunderstanding on electric motor rating turned a good attribute into a bad one. See Sections 2.28, 3.12.

6.6 Misinformation in the machine specification

Due to typographic error or otherwise, the data in a machine specification may not reflect the capability of the machine. Some errors could be discovered by cross checking redundancy data. Examples are

injection unit size rating = injection volume * injection pressure,
(see Sections 2.2, 2.3)
injection volume = (injection stroke) * 3.1416 * (screw diameter)2/4,
(see Section 2.9)
injection rate = (injection speed) * 3.1416 * (screw diameter)2/4,
(see Section 2.12)
injection pressure inversely proportional to the square of screw diameter,
shot weight (g) numerically less than injection volume (cm3),
clamping unit size rating = clamping force, (see Section 2.2, 2.3).

Data for which there is no redundancy could not be checked easily. An example is if clamping unit size rating is not specified, maximum clamping force could not be checked. In this case, the following checks could be done.

In a toggle clamped machine, assuming toggle magnification is 22,
maximum clamping force =
system pressure * clamping cylinder area * 22.

In a direct hydraulic machine,
maximum clamping force =
system pressure * clamping cylinder(s) area(s).

Measurement of maximum clamping force by load cell or measurement of tiebar tension could be done on a PIMM, although a moulder may not necessarily want to spend the effort.