Cost-benefit considerations

Are energy savings with rubber injection moulding machines really the most crucial topic? All in all, it goes without saying that every effort has to be taken to advance energy-efficient injection moulding machines for elastomer articles, but proportionality has to be kept. The use of resources in view of sustainable economizing has always be considered in its cost-benefit ratio. In this context special emphasis is given to the efficient material usage.

One emphasis of last year's FAKUMA was on energy saving with injection moulding machines. This topic is surely of specific current interest as far as thermoplastic injection machines with very short cycle times and the fast motion times involved are concerned. Here full-electric drive concepts play an increasingly essential role. However, the meaning for elastomer injection moulding machines in this ubiquitous discussion is overrated with regard to proportionality.
Having this discussion is important, as notably low-price machine suppliers from Asia use drive systems and temperature control technology that easily double or triple energy consumption. In-house tests resulted in an additional consumption of energy of up to 130 % applying tonnage sizes comparable to the one made in Far East. So, an alleged low-priced machine purchase often turns out to be an expensive error afterwards.
The European machine on the other hand is paid by the bare energy consumption after a few years only. Let alone the decisively better process control. Hence, this topic is a crucial argument in the discussion against the so-called low-wage competitors from Far East.
This discussion among the European manufacturers, however, takes place on a totally different basis, because the use of closed-loop controlled hydraulic systems and of drive motors type EFF1 has mostly been standard for many years. Motor cutoffs combined with soft starter controls make sense in case of long cure times, but due to the required plasticizing times this may not be overvalued either.
At a rough guess, in the production of elastomer articles around 1/3 of the energy is required for drives and 2/3 of the energy are needed for mould heating and temperature control.
The average energy share in the article price amounts only to approximately 1 - 4 % of all costs. If it is feasible to save another 10 % of energy by using mould insulation and drive motors of the latest energy class, e. g. the DFE1 variable capacity pump, this has only a very small impact on the article price – while not taking the non-negligible additional costs of several thousands of Euros into consideration.

The material share in the article price, in turn, amounts very often to 50 - 70 %. The share of waste with classical hot-runner moulds normally makes up between 10 and 70 %. Due to the use of cold runner systems, material savings can be realized that are many times higher than ever achievable through energy savings.

It is therefore important to break down the article manufacturing costs already in the project planning stage. This makes the cost distribution transparent and provides a

decision-making aid as to what measures are offering the best cost-saving potentials.

In its capacity as one-stop integrated systems supplier DESMA considers the complete production system.

Here are two good examples of these approaches:

Fig.: 1. example: O-ring production without cold runner block

1. **Example:** Full-automatic production of O-rings made of NBR with diameter 42 mm, cross-section thickness 3,2 mm on an elastomer injection moulding machine D 969.300 Sealmaster.

Hot-runner mould with:	***35 cavities***
Cure time:	65 seconds
Cycle time:	85 seconds
Compound price:	6.50 €/kg
Energy price/ kWh:	0.10 €/ kWh
Article manufacturing costs:	**2.37 € / 100 pcs**
Share of material expenses in production costs	58 %
Share of electricity expenses in prod. costs:	3.63 %
Total of annual electricity costs:	7,300.- €
Waste share:	75 % (40 g article weight/30 g waste weight per cycle)

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Cure time reduction by 30 % with FC+ nozzle technology

Article manufacturing costs:	**2.19 € / 100 pcs**
Share of material expenses in production costs:	62 %
Share of electricity expenses in prod. costs:	3.47 %
Total of annual electricity costs:	6,400.- €
Waste share:	75 % (40 g article weight/30 g waste weight per cycle)

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Use of open cold runner technology (5-nozzle CRB article ring arrangement)

Article manufacturing costs:	**2.16 € / 100 pcs**
Share of material expenses in production costs:	50 %
Share of electricity expenses in prod. costs:	4.40 %
Total of annual electricity costs:	8,100.- €
Material savings/a:	24,000.-€
Waste share:	39 % (40 g article weight /15.5 g waste weight per cycle)

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Use of* FlowControl *cold runner technology (5-nozzle article ring arrangement)

Article manufacturing costs:	**2.11 € / 100 pcs**
Share of material expenses in production costs:	48 %
Share of electricity expenses in prod. costs:	4.51 %
Total of annual electricity costs:	8,100.-,€
Material savings/a:	30,500.- €
Waste share:	29 % (40 g article weight/15.5 g waste weight per cycle)

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Use of* FlowControl+ *cold runner technology (5-nozzle article ring arrangement)

Article manufacturing costs:	**2.00 € / 100 pcs**
Share of material expenses in production costs:	50 %
Share of electricity expenses in prod. costs:	4.86 %
Total of annual electricity costs:	8,300.- €
Material savings/a:	30,500.- €
Waste share:	29 % (40 g article weight/15.5 g waste weight per cycle)

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Use of 2-deck cold runner technology (2x 5-nozzle article with ring gating)

Article manufacturing costs:	**1.82 € / 100 pcs**

Share of material expenses in production costs:	60 %
Share of electricity expenses in prod. costs:	4.44 %
Total of annual electricity costs:	6,900.- €
Material savings/a:	30,500.- €
(Annual production increased by88 % compared to 1-deck production!)	
Waste share:	39 % (40 g article weight/15.5 g waste weight per cycle)

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Due to changing the production method and due to the use of cold runner technology, the article manufacturing costs can be reduced by almost 25 %. Material savings owing to the usage of an open 5-nozzle cold runner block amount to 30,000.- € per year while power consumption runs up to 7 – 8,000.- €/a for the complete production. This corresponds to 3 - 4 % of the manufacturing costs. Further energy savings by 10 % due to mould insulation, motor cut-off and soft starters reduce the article price by 0,4 % only and the annual power consumption by 800.- €.

Fig.: 2. example: Rubber-metal bushing

2. Example: Production of NR-rubber-metal bushings, diameter 58 mm, with inner and outer tube – manual feeding – automatic demoulding out of splitable mould centre platen on a D 968.400 ZO Benchmark 750.

Hot-runner mould with:	***48***	***cavities (heating platens 670 x 940)***
Cure time:	260	sec
Cycle time:	360	sec

Price of compound NR: 4.6 €/ kg
Energy price/ kWh 0.10 €/ kWh

Waste costs/a **without** CRB: 78,000.- € (runner volume = 370 g per cycle, corresponds to 22 % of the shot volume)
Electricity expenses/a: 10.200.-€

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Use of an 8-nozzle cold runner block
(Reduction of the share in waste from 22 % to 12 %)

Waste costs/a **with** 8-nozzle CRB: 42,500.- € (runner volume = 200 g per cycle, corresponds to 12% of the shot volume)
Electricity expenses/a: 10,996.- €
Annual material savings due to the use of a 8-nozzle CRB 35,500.- €
(One-time extra investment for CRB 24,000.- €
+ temperation units and extension machine equipment 10,000.- €)

In this example the whole energy consumption amounts to around 11,000.- €/a. (A saving by 10 % results in a saving of 1,000,- €/a). The usage of a cold runner system, in turn, yields material savings of 35,500.- €/a.

Both examples show the relative meaning of the energy share in the total article costs.

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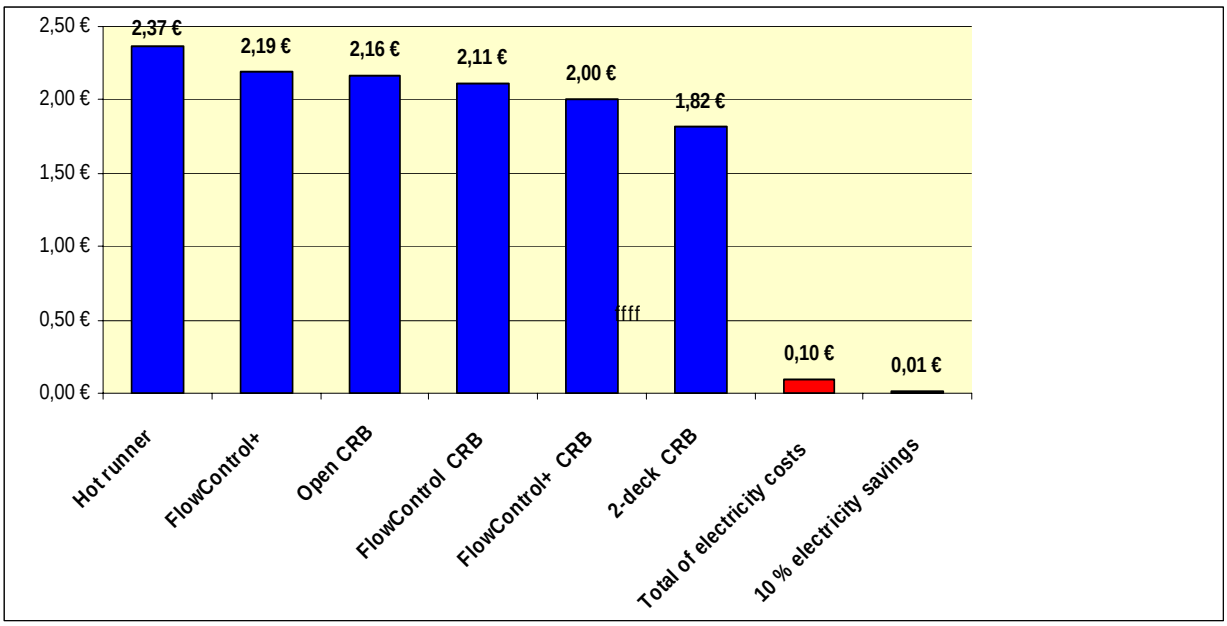
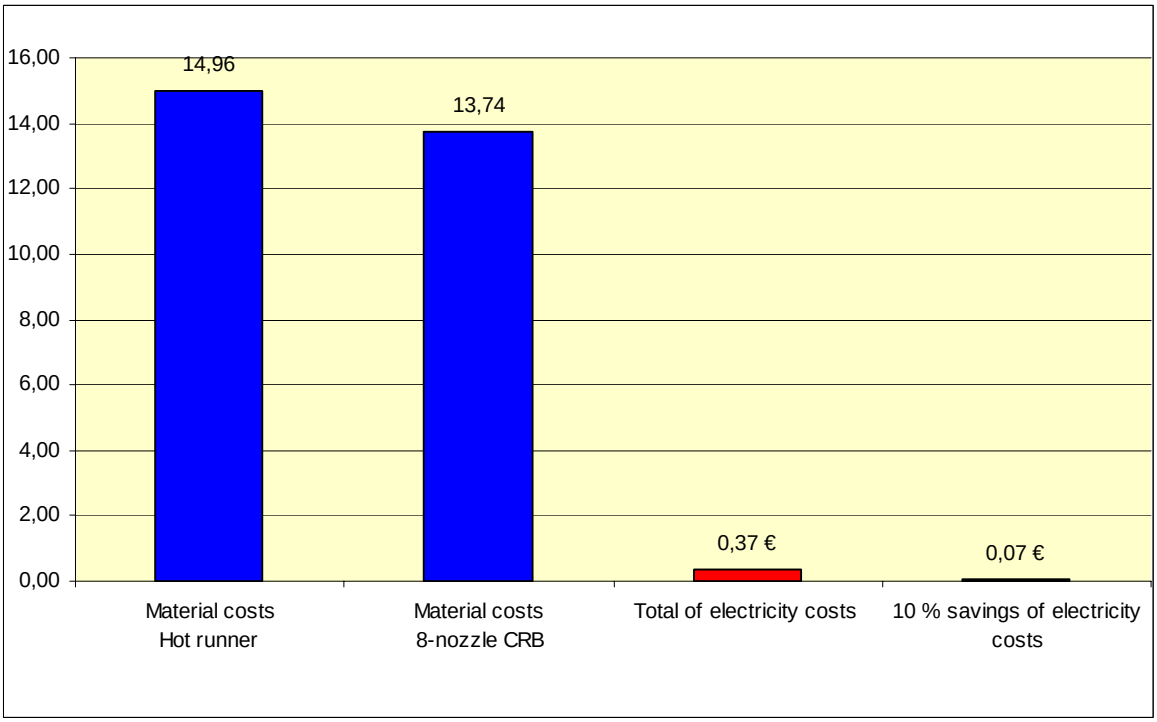
COST EFFICIENCY

The relative meaning of the energy share

The average energy share in the article price amounts only to approximately 1- 4 % of all costs. If around 10 % of energy can be saved, this has only little impact on the article price. The share of material in the article price often amounts to 50 - 70 %. The share of waste with classical hot-runner moulds normally makes up between 10 and 70 %. Due to the use of cold runner systems, material savings can be realized that are many times higher than ever achievable through energy savings.



The 2-deck production enables a cost reduction of almost 25 %.
If a 10 % reduction of the power consumption is possible, the production costs are reduced by 0.42 % only.



The use of an 8-nozzle cold runner blocks result in material cost savings of 35,500.- € per year. The annual electricity expenses amount to 10,000.- €. If here a saving of 10 % is possible, a yearly saving of 1,000.- € will be achieved!