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FRECH®

eFacts

Energy Efficiency: A Critical Success Factor

As a process that is highly integrated and productive, high-pressure die casting is also highly energy-intensive. In the wake of global climate-protection targets and policies the costs of energy have climbed higher year after year. And it is in particular due to globalisation continuing apace that the efficient usage of energy increasingly becomes a crucial success factor in international competition.

Also the "Blue Competence" Initiative of the German Engineering Association VDMA drives home the importance of responsible and efficient energy and resource usage. It appeals to its members' sense of responsibility, calling on them to lead by example. At the same time the association sends out a message of encouragement, by reminding us that very often, more can actually be achieved with fewer resources.

Resource Efficiency In the Spotlight

It is against this backdrop that Frech has established its new Resource Management and Die Casting Processes Division in March 2013. Together with its customers Frech wants to help the foundry industry at home and abroad to master the challenge. Together with my colleagues, Marina Wahl, diplomate engineer and Konstantina Stoltidou B. Sc., I would like to offer you the best of our support.

Drawing on projects we have carried out together with our customers and suppliers in the past, we have collated some interesting facts to show how you too can improve the energy performance of your die casting operations step by step. In future the information brochure eFacts will be published regularly to keep you abreast of the latest developments.

The reason why we have put the improvement of energy efficiency and productivity of die casting processes so high on our agenda, is our conviction that even in today's hotly contested markets, die casters can still enjoy good chances of business success, provided they consistently improve their performance in both respects.

Energy-Efficient Die Casting

One priority today is the reduction of energy costs. Currently, many die casters focus primarily on the tax-relevant aspects of their energy usage and record and document energy consumption which is eligible to tax deductions. A perfectly energy-efficient die casting process must also include all technical equipment of the die casting machines themselves, as well as the dies, tooling and peripheral devices. Furthermore, the best energy performance is attainable if process management and control systems are also optimised. This is where you can really derive maximum benefit from Frech as a full-line provider of high-pressure die casting systems. The Frech Group has extensive expertise on melting, holding and metering, die casting, temperature control and automation processes as well as tooling. Drawing on this strength Frech can offer you full, end-to-end support for your energy savings project.

Competent Partner

Any optimisation process must begin by taking stock of the actual state of affairs and drawing up a list of required actions. In many cases the priority will be on achieving the maximum impact within the shortest possible time while not losing sight of a reasonable cost-benefit ratio. Past experience in the past has shown that sizable returns can be obtained from investments into in greater energy efficiency in the foundry.

Before taking that step, however, you will have to choose a project partner who can support you in this endeavour. Apart from fundamental expertise on energy saving technologies, Frech possesses a high level of competence in the area of plant engineering and the operation of die casting production systems. Such know-how is indeed indispensable for those wishing to improve their production environments with lasting effect. We are convinced that together with you we will be able to unlock the potential for savings of your die casting operations and tap them fully to grow your profits.

Dr.-Ing. Kai Kerber
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Die Casting Processes Division
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Identifying the right levers – Analysing energy consumption in the foundry

Actions to optimise the consumption of energy and resources in the foundry should be rooted in an extensive analysis of the different loads. Such analyses help identify the biggest consumers of energy and resources and can serve as a useful basis to analyse costs, the returns on investments and to prove the effectiveness such measures.

Utility bills are the most accessible source of data for initial investigations of energy demand and related costs. As a rule energy bills are based on calendar months. They show the total energy used during the respective month, and frequently also how much energy was used during times at higher or lower tariff rates. Additionally, many utilities provide their customers today with load profiles for 15 minute intervals, thus allowing much more detailed analyses.

High energy demand for the melting process

Most die casting operators in Europe purchase electrical energy and gas to meet their primary energy needs. What almost all foundries have in common is that, irrespective of the type of alloy used for casting, 50% of the energy goes towards the melting processes. In many foundries, and in particular in aluminium foundries, allocating usage to the respective energy source is easy, because gas is used exclusively for melting in large, centralised melting furnaces and the energy used for the melting process can be determined by analysing the invoice.

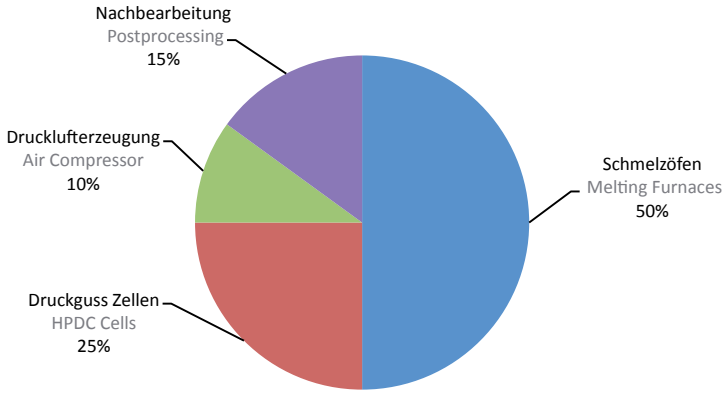
Metering campaigns can be carried out to structure the analysis of the internal energy demand of foundries – a service which Frech also offers its customers. Such metering campaigns can be performed at different degrees of resolution, i.e. the analysis can focus on specific sections of the production process, a representative machine or entire casting cell, or, at a maximum level of detail, capture every single energy load in the foundry.

Distribution of energy demand

Such metering campaigns help to show that the production cells in total account for around 25 to 35% of energy demand, i.e. they are the second biggest users of energy in the foundry. These are followed by air compression equipment, the third biggest consumer, requiring 10% to 20% of energy. Processes such as simple finishing operations of castings or machining, lighting equipment, IT and small consumers account for the rest of the energy consumed in the foundry. This distribution will not always be exactly the same for each and every foundry, nevertheless with some shifts of emphasis it can be applied to most foundries, as the amount of energy required for melting and for the generation of compressed air are linked to the number of production cells and their respective output.

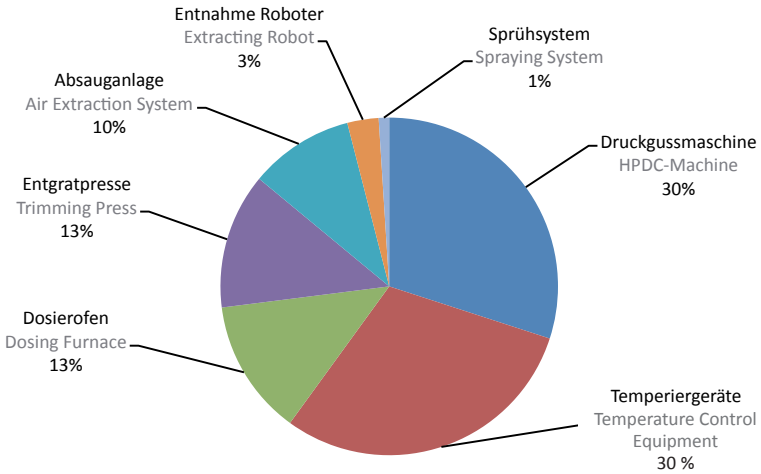
Expert knowledge required

If metering needs to be performed in connection with die casting cells, it is not advisable to use the services of metering service providers who are not a familiar with high-pressure die casting operations. The variety of different machine states and process conditions often leads to errors during the metering process itself or to the misinterpretation of meter readings. To give an example, some loads in the production cell, such as the die casting machine, trimming press, spraying equipment or extraction robots have a cyclical load profile which follows that of the production cycle. In the case of



other equipment, such as machine, holding and dosing furnaces or heating and cooling devices, however, the load profile cycles are completely different and in some cases do not follow the production cycle at all. In these cases it is therefore vital to take the actual status of the device into account in the analysis, as well as all relevant operating parameters, and to select a specifically adapted mode of analysis for the load profiles. To illustrate this it is sufficient to point to the influences of the different types of casting processes. Die castings cells which are used for the production of structural components have energy and resource consumption patterns which are entirely different to those of machines used to cast cylinder crankcases. For such applications, the heat balance as well as cycle time are significant influencing factors on energy and resource usage.

Frech offers metering services to enable detailed analyses and comparisons of production machinery and cells. The metering results can then serve as the point of departure for different optimisation schemes.



Resource Efficiency – A key challenge for the Europe's die casting Industry

In the face of increasing climate change the European Union has set itself ambitious targets for climate protection and energy savings and has seen increasing efforts to implement them in recent years. High-pressure die casting is a process which is very robust, highly productive and therefore also highly energy intensive, which is why actions decided at EU level to protect the climate are having a big impact on foundries.

Aside from the reduction of greenhouse gas emissions and the increasing use of renewables, the EU has decided to bring down primary energy usage by 20% by the year 2020. An ambitious energy savings target to cut primary energy usage in half has been formulated for the subsequent period extending to the year 2050. To meet these targets the member states of the EU have developedand adopted a range of different climate policy instruments at the national level which are now entering the process of implementation.

Added costs for the diecasting industry

In view of the necessity to safeguard the international competitiveness of the German Industry, the German Renewable Energies Act, or EEG in brief, is highly controversial. The renewables reallocation charge payable under this law clearly impacts the cost of electrical energy. The resulting increase in costs has become ever more important for the German die casting industry in recent years. Even though high-pressure die casting is a highly energy-intensive process, many companies cannot apply for an exemption from or reduction of the reallocation charge payable under §41 subs. 3 EEG, as their energy costs do not exceed the critical threshold of at least 14% of the company's GVA (Gross Value Added). EBIT margins in the foundry industry are modest, but are bound to be dented considerably more by this additional burden.

Tax refunds

Foundries can apply for tax relief for electrical power and gas which is used for operating purposes and in particular for thermal processes. Primarily such tax refunds are available under § 9a and § 10a of the German Electricity Taxation Act (StromStG) and under § 55 of the German Energy Taxation Act (EnergieStG). In order to successfully claim these refunds, companies have to give proof of their specific consumption by metering it or they need to have an Energy Management System according to DIN EN 50001 in place. Alternatively, they need to have performed an Energy Audit according to DIN EN 16247. On top of this many end users of casting products have introduced Corporate Sustainability Programmes and prescribe energy efficiency to their suppliers as part of their procurement practices. In response an increasing number of foundries are now introducing Energy Management Systems according to DIN EN 50001 and energy efficiency as such is gaining ever more ground in day-to-day production.

Targeted sets of measures

In general, the energy and resource efficiency of existing die cast ing operations cannot be broken down to the level of individual processes, units or production processes, which is why a comprehensive assessment is needed and improvement programmes should be implemented in a targeted manner. As a system supplier, the Frech Group offer high-pressure die casting machines as well as peripheral equipment and even turn-key foundry systems and have extensive technical expertise in all aspects of castings production. This makes Frech the ideal partner for production-focused consultation and in the implementation of projects aimed at optimising energy and resource efficiency in the long term.

Frech as project partner

The Division "Resource Management and Foundry Processes" will serve as project partner to foundries in Germany and abroad. A focal area of its work will be dedicated to developing technologies which help improve the energy efficiency of high-pressure die casting machines and peripherals up to entire die casting operations. Consultation, the installation of monitoring systems, data analysis as well as the planning and joint implementation of optimisation programmes are offered as services by the Frech Group.

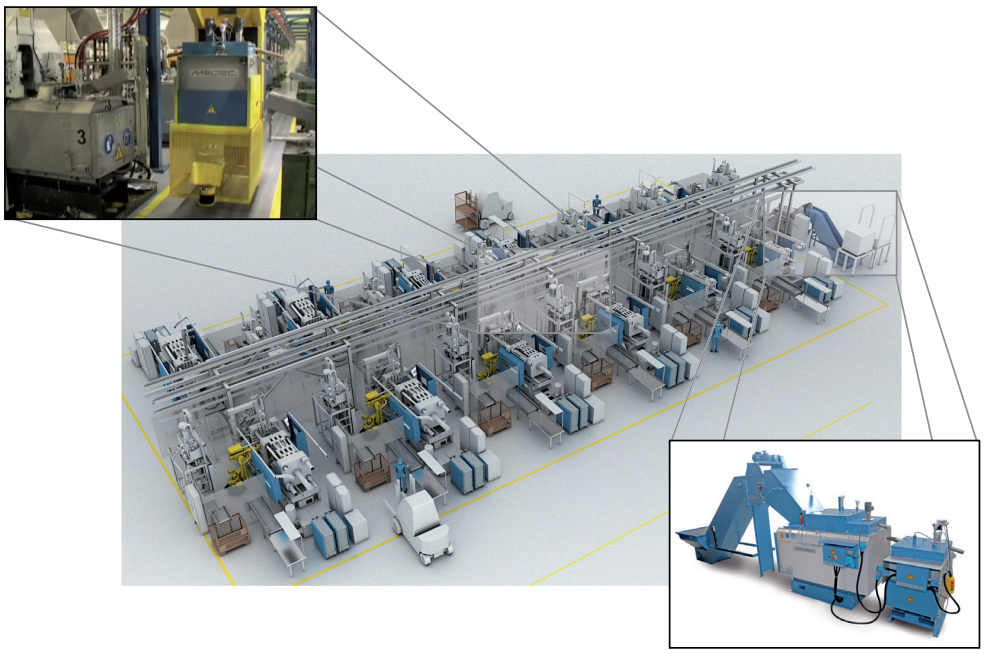
With eFacts, Frech would like to give you the opportunity every 6 months to better inform yourself in the area of energy and resource efficiency. This will give you ideas for your own products and services, as well as implementation examples.
Would you like to tell us about your own success story, or do you have questions or ideas? In that case, we look forward to hearing from you.

Melting and Holding – present a wide range of opportunities for cost optimisation and more energy efficiency

Due to the diverse nature of metallurgical tasks, almost all aluminium foundries today have established efficient melting processes in furnaces with large capacities. Nevertheless, improvements in different ways are still possible, even here. Centralised melting and melt feeding processes have not really become very wide spread in the field of hot-chamber die casting today, even though such configurations offer significant potential for cost and energy savings.

Melting with gas

Holding and dosing furnaces in today's state-of-the-art foundries are predominantly powered by electrical energy. From a technological perspective this offers significant advantages, in particular in terms of melt quality, temperature control and melting losses. Be that as it may, it remains a fact that the cost of gas as an energy resource currently amounts to only a third of the cost of electrical energy. By shifting from costly electricity as an energy source for melting processes as much as possible in the direction of gas, costs can already be reduced significantly. For a variety of reasons a complete switch to gas-powered furnaces would make little sense at this time, however, neither in the field of hot- nor in that of cold-chamber die casting. The objective should therefore be to cogently combine both technologies in order to achieve the best possible result in terms of productivity, quality and energy costs.



Efficient thermal recovery

Many cold-chamber casting operations use gas for the melting process and feed electrically powered holding and dosing furnaces with the molten metal. Different burner and furnace technologies help improve the energy performance of large-scale melting furnaces. Another, additional option is the economically viable utilization of waste heat recovered from the furnaces' waste gas stream.

Energyefficient systems from MELTEC

Where the temperature and timing of moltenmetal feeding processes are properly controlled, it will emerge that the energy used for holding and dosing furnaces is essentially only needed to keep the molten metal at target temperature. Mostly energy waste only occurs where furnace linings or heating devices are defective or where furnaces are fed with metal which is too cold. Furthermore, also the use of ladling technology is associated with slightly higher amounts of heating energy which is required due to the cyclical immersion of the relatively cold ladle in the molten metal bath. In the case of long cycle times it is therefore advisable to ensure that ladles are heated by suitable equipment.

This kind of optimisation potential in the operation of foundries can easily be identified with the help of energy data loggers which capture what goes on in the furnace at a time resolution of less than 5 minutes. Even at lower time resolutions, defects in the furnace system can be detected and their impact on energy consumption calculated with the help of long-term trending functions. In addition, the logged energy data can be used as evidence in the context of different tax refund processes.

Maintenance saves energy

Only a few hot-chamber foundries are using feeding systems with molten metal. However, under certain circumstances - such as sufficient space, minimum number of machines, suitable configuration/footprint of machines - the installation of a fully automatic molten metal feeding system as offered by Frech's subsidiary MELTEC can have several advantages. If gas is used as energy source for the melting process, high cost saving can be expected. However, there are also advantages in terms of better melt quality, internal foundry logistics and consistent temperature profiles of the molten metal bath and hence greater process stability. The costs of installing such systems are recouped very quickly, depending on the number of connected machines. It is also possible install an only partially automated system to reduce capital expenditure or to install it step by step. These systems can be combined with highly economical gating and slag recycling systems resulting in even higher cost and energy savings.

Variable Frequency Drives – more energy-efficient under certain conditions

The use of variable frequency drives as an effective means to improve energy efficiency in many areas is a widespread recommendation. It should not be forgotten, however, that this is only true under certain conditions.

Energy efficiency through software update

Most high-pressure die casting machines today are powered by hydraulic drive systems. Depending on the size of a machine, it will usually be equipped with one or two AC induction motors with fixed speed, containing either several fixed speed multi-stage pumps or a combination of fixed speed pumps and variable speed pumps. Apart from the number and type of different pumps, careful grading of the different pump stage capacities and their activation during the machine cycle are the predominant factors in terms of energy usage. In some cases significant improvements in energy performance can already be achieved for example by optimising the hydraulic power supply during the machine cycle – which is a simple software update.

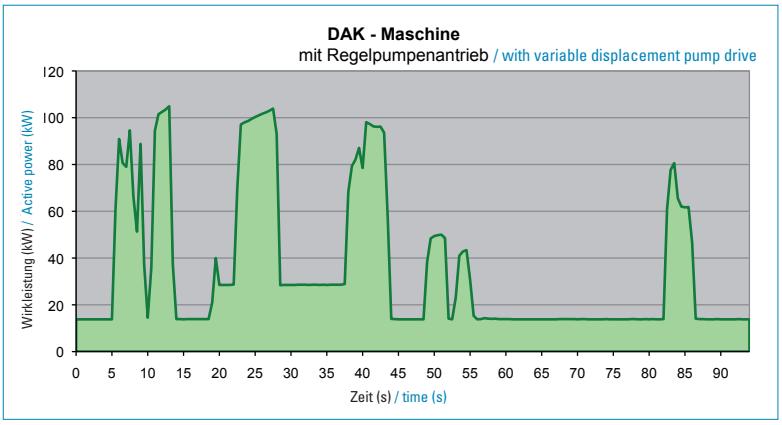
Reduction of base load

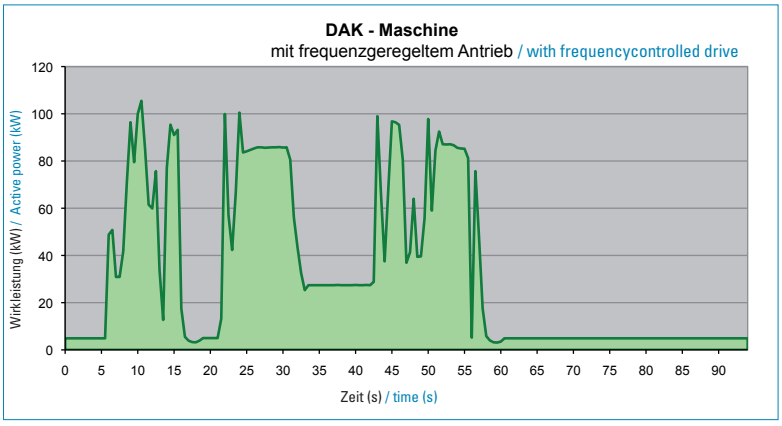
Apart from the dynamic loads generated during the machine cycle by different motion sequences and loading operations, the hydraulic system is also subject to a permanent base load. Contributors are dynamic pressures, leakages and the efficiency of electric and hydraulic drive components in the low power range. Additionally, a minimum pressure level must be maintained in the system at all times and the drive system capable of delivering it, to ensure the safe and proper functioning of the hydraulic switching and control components in all machine states. Base load is still being consumed even while a die casting machine is standing still, for example during waiting times in the cycle (due to metering, extraction and spraying operations or cooling). If variable speed pumps are used, the volumetric output of the pump systems can be reduced during times while it is not needed to reduce the amount of base load consumed. A relatively simple solution to reduce base load demand as described here is possible through the use of variable frequency drives. Such drive systems can supply a wide range of different power levels seamlessly without requiring profound changes to the machine's hydraulic sys-tem. Another advantage is that fixed speed pumps can be used for the low power range of such drives that are more efficient and easier to maintain.

Carefully chosen drive

There are two important basic requirements that must be met for frequency variable drives to improve the energy performance of die casting machines successfully: sufficient know-how regarding how much hydraulic power is needed for different machine states, and there must be sufficiently long time periods during the production cycle during which the speed of the drive can be reduced to such an extent that the resultant base load is lower than that of alternative drive variants. Especially in the case of hot-chamber die casting machines with fast cycles, or highly optimised cold-chamber die casting cells, the time windows during which the drive power can be reduced in this way are very short. Also the start-up and braking times of the drive system can prove to be problematic. So to avoid a trade-off in the shape of longer cycle time in the case of large machines with relatively inert drive motors, complex and self-learning software technologies will be needed which take the respective start-up and braking times of historical machine cycles into account during the actual production cycle.

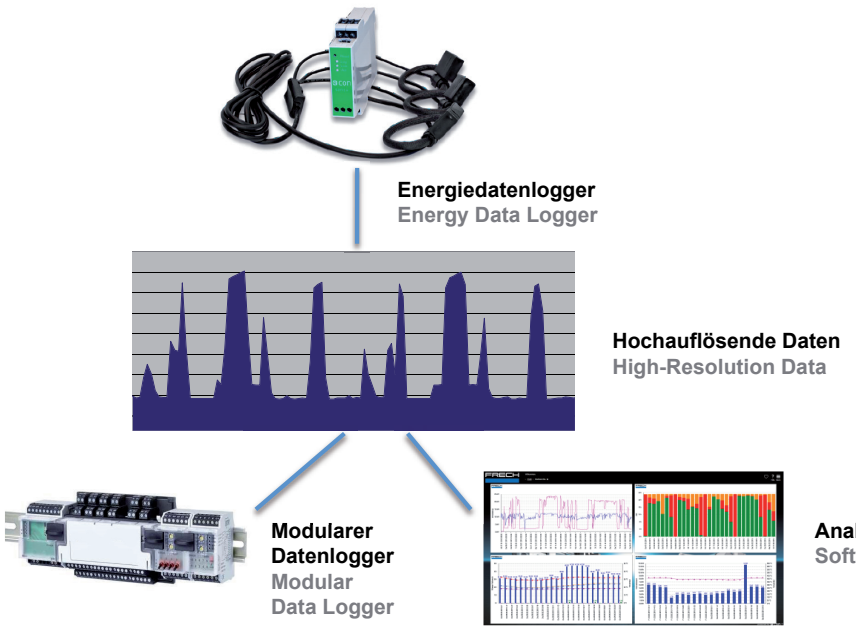
With this in mind, we have equipped the appropriately sized machine models of our new cold-chamber series with variable frequency drives to ensure energy-efficient operation of the die casting machine and also greater ease of maintenance.





Energy Data Logging – identifying interactions and component-related energy costs

Logging the data of different variables at appropriate time intervals is the key to understanding how different machine states, process parameters and the energy and operating media required for die casting processes interact. Linking such data with just a little additional information about the production process will yield a wide range of useful insights.



From the sensor to the overall system

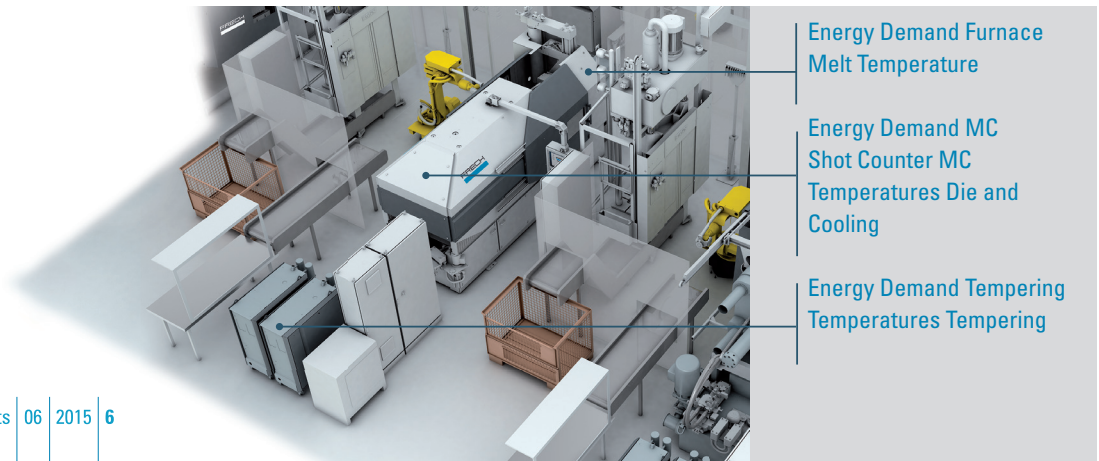
By conducting a detailed analysis of the energy and operating fluids, demand data of die casting processes - logged at a large number different metering points at suitable time intervals - such data can be rendered useful for different purposes. The wide range of applicability includes their use to document the total energy consumption of monitored devices, to analyse the amount of energy and operating media required to produce individual batch sizes and even to evaluate every single load profile of production cycles and states of individual die casting machine components. For this purpose Frech offer expandable modular monitoring components as well as whole turnkey systems to measure energy and resource consumption. The system components can be installed at the foundry shop floor level as well as in other divisions or departments of companies to set up a comprehensive and consistent data logging system for energy and other operating media that includes the entire enterprise. Existing smart meters as well as a wide range of different sensors and data sources can be integrated into this data logging system.

Understanding energy demand

Causal relationships such as the effect the cycle time or the temperature balance have on the total energy balance of the die casting process remain all too often unknown in the everyday running of foundries, due to the complexity of the different interactions involved and because energy consumption as such is not palpable enough to be registered by the human senses. Almost always, machine operators and managers are not really aware of the causal connections between different production situations, process and machine parameters and the amount of energy needed for production. Which is why, by actually measuring energy consumption and visualising it, foundries can make the first successful steps towards optimising the energy efficiency of their die casting operations Decisions regarding labour organisation can be explained and their impact visualised and communicated at the shop floor level in a way that is easy to understand.

Comprehensive services

In this context Frech offer end-to-end planning and installation services of system components, comprehensive aftersales services as well different data analysis packages. The data logging systems and our comprehensive range of services allow our customers to define and implement effective optimisation programmes already after a short while and to validate their effectiveness in the context of energy management systems according to DIN EN 50001 or audits according to DIN EN 16247-1. Above and beyond this, however, there are numerous other possible uses of the data, such as the monitoring of the quality and robustness of foundry processes, the calculation of energy costs and CO2 emissions per components, the evaluation of the technical condition of production equipment and the analysis of machine downtime and its causes.



Energy Savers – Small Tools with Great Effect

Even small-scale actions can contribute greatly to achieving more energy-efficiency in foundry operations without necessitating fundamental changes toproduction organisation and production machinery.

Energy efficiency during non-productive periods

In many foundries the energy consumed during stoppages in the production process can account for a considerable share of total energy consumption. This applies in particular to situations where, in spite of foreseeably longer periods of downtime, drive systems of production machinery remain switched on, while heating and cooling devices, furnaces and other peripherals also remain in production mode. During such periods the production equipment keeps consuming energy without adding value. Apart from awareness-raising and training of machine operators by permanently visualising the energy use of machines and production cells, simple shut-down routines that are built into the machine's control system can be a highly effective means to prevent the wasting of energy almost completely while production equipment its standing idle.

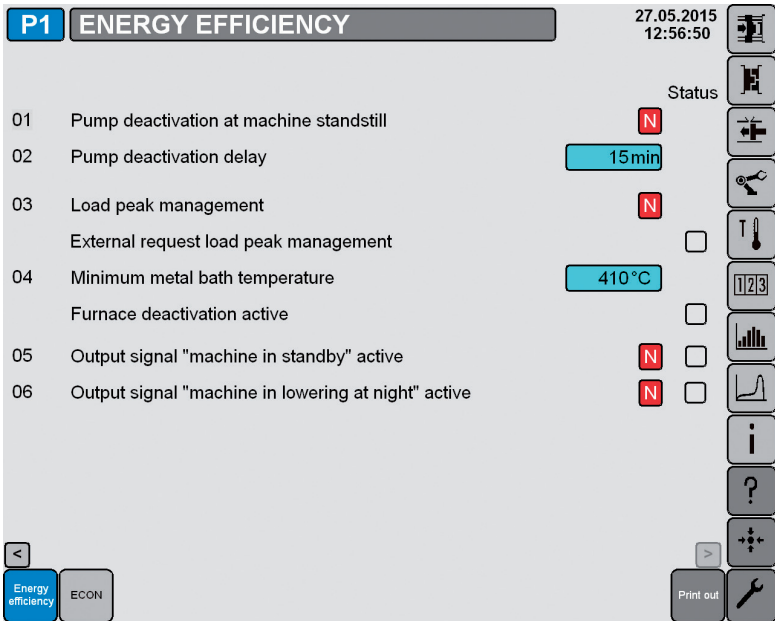
Energy-saving mode of operation

After having shut down the drive systems of die casting machines, an additional stand-by signal can be transmitted to peripheral equipment connected to the die casting cell, such as the dosing furnace, heating and cooling devices or the exhaust system. The signal prompts them to change into energy-saving mode to reduce the usage of electrical energy and other operating media, such as compressed air or water for cooling.

Here Frech offer shut-down programmes for hot as well as cold-chamber die casting machines which can be configured with the help of the machine's visualisation system. The shut-down signals can be transmitted to peripheral devices across interfaces which can be retrofitted.

Intelligent reduction of energy costs

Peak load management systems help bring down energy costs of die casters through active avoid-ance of more expensive peak load demand, which utilities use as the basis for billing energy supplied during the respective billing period. This is a technology which can be implemented in cold- as well as hot-chamber die casting foundries and has been used to great effect by many die casters for a good many years now. Energy demand, in particular the energy needed for dosing and machine furnaces or heating and cooling technology, tends to fluctuate widely during production, ranging from almost zero to peak values within very short periods of time. As a rule there is no overarching process control or other control system to monitor production systems and their respective switching patterns or to switch them in a targeted way. It is for this reason that



peak loads occur when machines and devices by coincidence simultaneously switch to higher power levels which then result in high energy costs.

Selective deactivation without loss of quality or productivity

In a typical cold-chamber foundry, but also in hot-chamber foundries, dosing and machine furnaces can be shut off for defined periods of time due to the prevailing physical conditions without detrimental effects to the quality or effectiveness of the die casting production process. Peak load management systems harness this effect to harmonise energy consumption and avoid or minimise peaks in the foundry by shutting down such loads in a targeted way. In some cases even the different power levels of heating and cooling equipment can be integrated into the peak load management system. In this case, the energy savings here are not due to increases in energy efficiency as conventionally understood, but rather to a harmonisation of loads which ultimately results in lower energy costs.

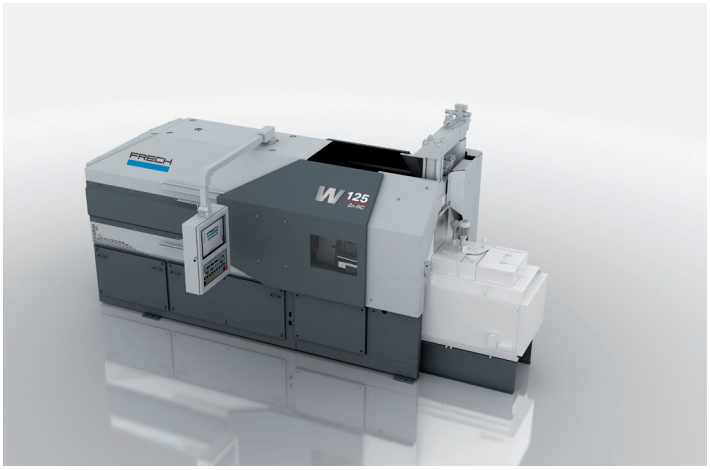
Frech offer peak load management systems as well as the related planning services - they are included in the scope of services and products offered by us. If required, we are pleased to provide you with an estimate of potential savings based on a load profile analysis of your die casting operations.

I-4-FACTS – What the coming of Industry 4.0 means for the Die Casting Industry

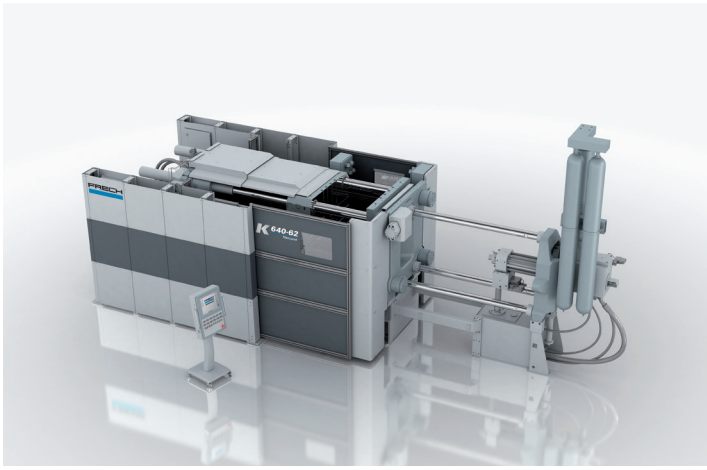
The German Government's high-tech strategy dubbed the Industrial Revolution 4.0 - or Industry 4.0 in brief - is the trend everybody is talking about at the moment. But what does it mean? What exactly is the Internet of Things and how can we, the die casting industry, benefit from it?

Apart from global conflicts, the progress of globalisation, the stability of the Euro zone and the German Energiewende (Germany's break with nuclear power generation) we hear about what has been termed the Industrial Revolution 4.0 practically every day. An Internet of Things will be created, people say. Industry and production will be computerised. The talk is of component-driven production and of buzz words such as Big Data and standardised data interfaces. But how will this go together with a primary forming process such as high-pressure die casting, and will small and midsized enterprises get the chance to computerise their production processes, too, in order not to be left behind? Frech customers are prepared thanks to our OPC data interface "Industry 4.0", but what will come next?

Together with our customers, we from Frech would like to discuss all these as well as other questions in the upcoming years, because we want to make sure that the die casting industry will not just participate in the digital revolution, but set benchmarks, too. Therefore we will publish the first edition of "I4-FACTS" before the end of this year. We would like to encourage you to actively use the opportunities Industry 4.0 present, and you can rely on us to support you!



Hot-Chamber
Frech hot-chamber die casting machines are used for the production of castings made of zinc, aluminium and magnesium. They have locking forces of between 20 and 800 tonnes, and are powered by hydraulic, fully electric or hybrid drives.



Cold-Chamber
Frech's cold-chamber die casting machines have locking forces of between 1.300 and 44,000 kN. They are used for casting small OEM parts as well as engine blocks or gearbox housings, and even body and chassis elements made of aluminium or magnesium alloys. The patented Vacural technology for vacuum die casting has placed Frech at the top of the world of light-weight processing technology.

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