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SEMI-SOLID METAL CASTING TO MEET CAFE STANDARDS

(CORPORATE AVERAGE FUEL ECONOMY)

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Energy Conservations in Die Castings Industry - Some Practical Examples

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Abstract

The manufacturing sector is undergoing a serious challenge amidst the global economic slowdown. We need to look at the internal, as the external environment is out of our control. The major areas that the industry could look into are cost cutting measures and energy conservation, with the latter being the most significant amongst them.

The die casting industry is highly energy intensive, and there is a lot of potential for energy conservation.

This paper will highlight some of the measures implemented successfully, thereby helping fellow die casters in order to apply the same ideas in their organizations.

Introduction

CRP (India) Private Limited is a leading manufacturer of High Pressure Die Casting Products in India. It was founded in the year 1975 by Mr. N. Kunchithapatham, one of the pioneers in the country, in the field of die casting in terms of design and manufacturing of HPDC dies as well as production of castings.

CRP is a one-stop solution provider for the HPDC Products, having expertise in product design, die design, die manufacturing, die casting, machining, surface finishing, powder coating, assembly and testing.

CRP has joined with Twin City Die Castings Company (USA) in September 2009 to promote a joint venture in India called "CRP-TCDC Die Castings India Private Limited (CTI)" to cater to the growing needs of technical and engineered die castings.

The adaptation/implementation and effective use of newer technologies in the field of die casting has made CRP a cost-effective and preferred source for the customers. The most important of these implemented technologies are those pertaining to energy conservation. Most of the power is consumed by the melting furnaces and the die casting machines themselves. Recent technological developments, such as energy efficient tower furnaces and the all-electric die casting machines are already available to the die casting community to adopt and solve. The efficiency of this equipment has improved significantly due to global competitions and continual improvements. Numerous solutions are being provided in this regard from a huge list of suppliers and hence are not included in this paper.

Instead this paper will highlight some interesting examples of practical energy conservation solutions adapted, their simplicity and their benefits. This will be very useful not only to our fellow die casters, but to the industry as a whole.

Examples

The following examples explain the many approaches towards the application of various energy conservation solutions in the die casting facilities.

Example 1: Use of Natural Light

Natural light is one of the significant sources of energy and it is often ignored at many shop floors and offices. In tropical countries like India, this can be augmented for up to 12 hours thus leading to substantial saving of energy.

The buildings and offices were designed and some modified so as to allow the natural light to come in. Depending on the need, the intensity of light was reduced by making use of vertical blinds in the offices. If the heat input to the room is too high (east and west walls) then a double glazed glass is used to prevent the excess heat from entering into the room. This becomes more important in the case of air conditioned rooms.

Figure 1 – Shop floors with natural light rooftops.

In the shop floors, the number of natural roof panels is decided by the exact need of lighting levels and locations. These roof panels are made of fiberglass or polycarbonate material - having very good light transmission with up to 99% UV shielding, stabilized, strong and lightweight. These panels are weather and temperature resistant. These panels are also incorporated into the side walls to allow more natural light. In addition to being natural and energy efficient these lights improve the ambience of the workplace.

Figure 2 – Die casting shop floor with natural roof panels.

Whenever there is a fluctuation of light in the day time, the automatic light sensors are introduced into the circuit to on/off/dim the lights. This is ensuring the ideal light with optimum power consumption. The less frequently used areas such as rest rooms and corridors are fitted with motion sensors with auto on/off and daylight sensing features to further save the otherwise wasted energy.

Example 2: Use of Natural Ventilation

There are several sources of heat, fumes, smoke and vapors in the foundry and they are necessary to be exhausted out of the shop floors continuously and efficiently. Generally a lot of energy is used for this purpose.

Figure 3 – Roof extractors over the die casting shop floor.

Extractors are fitted on to the high points on the roof at periodic intervals and also over some specific hot spots such as furnace areas. These roof extractors use the natural flow of air on the surface of the roof coupled with the flow of air through the extractors, in order to rotate. No power is needed here thereby saving substantial energy. They seldom need to be maintained.

Example 3: Natural Draught Cooling Towers

Cooling towers are one of the utilities that are switched on first and switched off last. In colder countries they are not switched off even during the holidays so as to prevent the circulating water from freezing.

Any small saving of energy here is going to be of great significance over the years. The natural draught cooling towers use special nozzles to atomize the water and coupled with the natural flow of air, it tends to bring down the water temperature.

It uses the circulating pump pressure itself for this purpose thereby eliminating the power used for the forced flow fan motor.

Figure 4 – Natural draught cooling tower near the die casting shop floor.

They are simple in construction (FRP), and easy to repair and clean. Maintenance is almost none. The return on investment is typically around 6 months.

However they need a high footprint in terms of area, as well as the height, but they could be accommodated in any open space such as gardens, roofs, etc. The energy saving outweighs this simple shortcoming.

Example 4: Compressed Air Management

Compressed air is an expensive and power consuming input to the die casting shop but is quite often ignored. One CFM (cubic feet per minute) is equivalent to approximately 0.25KW. There is a huge potential for the conservation of energy through the optimization of the air usage and the cost of generating the compressed air. Also, the compressed air utilities are similar to the cooling towers, as they are kept switched on as long as the plant is running.

On a casual visit to a manufacturing facility which produces doors for an automobile, we found heavy sounds of equipment based on compressed air. Our scrutiny revealed that the installed capacity of 3000 CFM for the compressed air far outweighs their actual needs and the team suspected an excessive leak from the components in the air circuit. We suggested their plant maintenance team to test it out on a holiday.

The test was conducted by switching off all equipment and running as many compressors as required to compensate for the leaks. By observing the loading and unloading time cycles of the running compressors we arrived at their leaking capacity, which was as high as 1500 CFM, more than 50% of overall consumption. This was an eye-opener and we decided to make the same study in our own company.

We found that our leakage was more than 20% and the following remedial means were taken:

- Replacing the leaking components - pipes, fittings, etc.
- Replacing the rust prone GI pipes with aluminum and plastic pipes.
- Introducing air foot switches to the air gauges, which otherwise will leak the air constantly.
- Periodic replacement of effective parts in time.

It is suggested from the above study that every die casting plant should include an air audit in their system. They may also use an in-line electronic air flow measuring equipment to monitor and control on an ongoing basis.

Over and above these, we also saved a significant amount of air through many initiatives, such as optimization of the spray systems (another major area), re-engineering of the pipe lines in terms of size and friction.

The cost of the generation of compressed air also needs to be addressed as it is very energy intensive as well as a constant source of energy dissipation. Hence we have benchmarked and invested in the makes and models from international brands, with very optimum specific energy consumption. Only a few brands in the market are prepared to share their specific energy consumption charts, and we have not considered for investment, those who do not share these inputs.

Another key area of focus should be the sizing and number of the compressors. It is advisable to split the capacity of the compressors into multiple units so that we will have the flexibility to run the capacity close to the demand. The efficiency is maximum when the compressors are running close to the full capacity. Also, we can apply a master-slave system, which is available today with most of the leading manufacturers, in order to manage the demand vs. capacity.

Figure 5 – Compressor bank (left) connected and controlled by an air manager (right).

CRP has invested in an air manager to manage three compressors with different capacities - 100, 200,400 CFMs and one 200 CFM Variable speed (SFC). This helps in managing the optimum energy consumption by ensuring the correct status of each of the four compressors in the bank depending on the ever changing air demand.

Example 5: Wind Energy

The alternate forms of renewable energy have been a subject of debate for the last few decades. Its time has already come with changed scenarios, as some of the sources of renewable energy are not only green but economical as well.

Leading this pack is wind energy and it is growing very fast in terms of percentage of share in energy generation and number of installations. India is a leading player here, and CRP has utilized this opportunity by regularly investing in wind energy. Today 75% of our need is harnessed through wind energy. They are located about 500 km away, where optimum potential for the wind exists.

Figure 6 – Wind turbine installation.

The local energy distribution company, owned and operated by the state government, takes care of the management of absorbing the generated power and compensating the same for our plants. The responsibility of the upkeep and maintenance of these equipment are with the supplier.

These initiatives are ensuring us not only that the energy is available, but is also economical.

Example 6: Lighting Optimizations

The shop floor lighting needs to be adequate. Inappropriate lighting will lead to eye strain and fatigue to the employees. The excess lighting will contribute to power loss which otherwise can be saved. Generally the shop floors will contain lots of imbalances in lighting at different areas in terms of poor or excess illumination with pockets of areas with appropriate lighting.

Time and time again, die casters have used and mastered various simulation techniques for the design of the part and the process. When it comes to shop floor design they tend to depend on external experts with little knowledge of the die caster's perspective. Today the lighting industry has highly matured and offers a numerous easy-to-learn and to apply software tools.

There are several free tools (i.e. Calculux) along with excellent support, and they are available over the web, particularly with luminaire manufacturers. These tools use the product libraries of various brands around the world, to readily pick and place the appropriate combinations of lights and fittings.

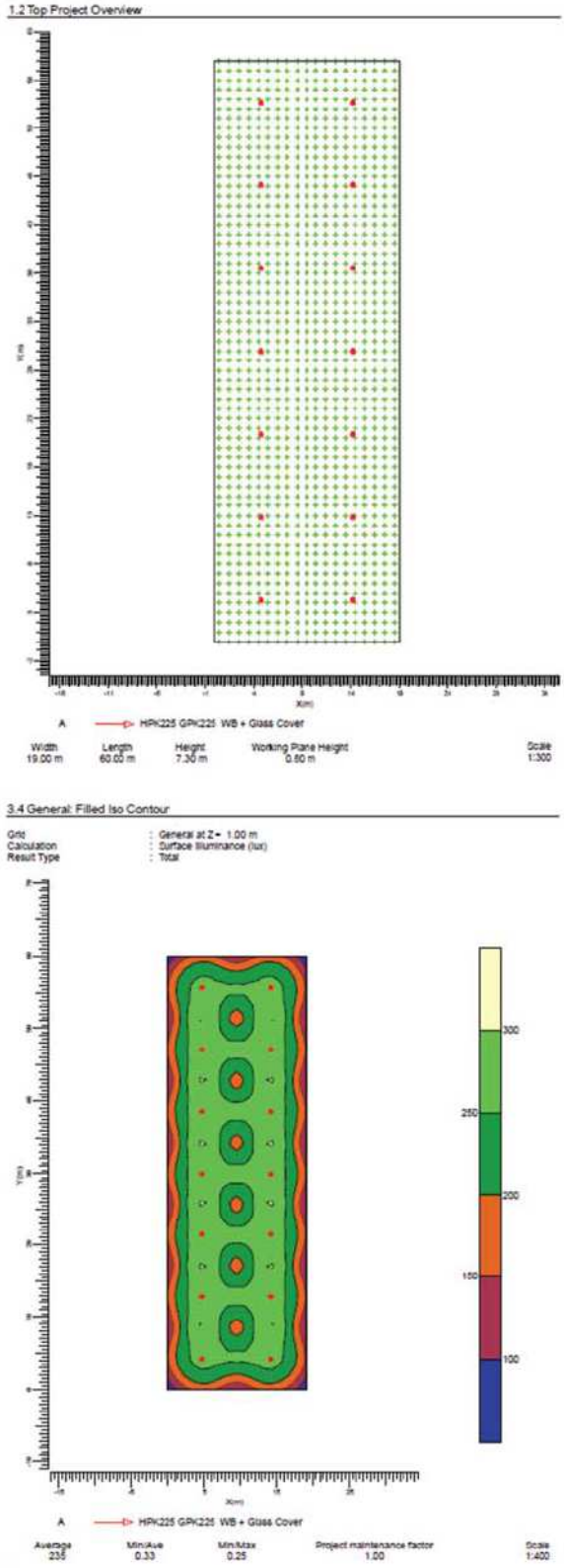

Figure 7 – Proposed 2D-layout with location of fittings (top) and ISO contours of light distribution (bottom).

CRP has tried to adopt these tools by conducting a sample study. A conference room with known light fittings is modeled and simulated. The results were correlated with actual measurement with a simple lux meter and found within a difference of 2%. This has encouraged the team to use these tools in the future projects to optimize the illuminations in the shop floors and offices. In one of the immediate projects the contractor suggested 24 fittings for a particular shop floor, whereas the analysis optimized it to just 14 fittings with balanced lighting. A saving of more than 40% (2.5 KWh) on power consumption and as well as investment are achieved.

The steps are as follows:

- Input the simple 2D sketches/dimensions of the shop floor layout into the software.
- Define the measurement plane/working height.
- Choose appropriate products from the libraries from the manufactures available online.
- Define the fitting height of the luminaires.
- Mark the areas with the recommended illumination in terms of lux.
- Run the simulation.

The professional output gives a detailed report which includes:

- The proposed layout with location of fittings.
- Various views.
- ISO contours of light distribution.
- Textual and graphical tables.
- Mountain plot.
- Detailed Costing sheet.

The detailed costing sheet is very accurate with necessary financial inputs - cost of power, burning hours, investment cost, maintenance cost, etc. The precision can be further improved by defining the life of bulbs, maintenance factors, and so on.

One can learn these simple tools in about a day and finish the projects within few hours. This gives adequate opportunity for multiple iterations and optimizes the illumination and cost. For those who are serious about lighting and need a detailed analysis much more advanced tools are available in the public domain. All that is required is the will to try, apply and save on energy costs.

Example 7: LED Illuminations

As a continuation of the previous example there are plenty of opportunities to further reduce the cost of lightings by replacing the traditional luminaires with LED.

LED luminaires have come of age in terms of their applications, availability, reliability and economy. Despite being a costly option, its advantages outweigh the shortcomings:

- Consumes very little energy, less than 10% of incandescent lamps and less than 50% of CFLs.
- Power demand and infrastructure cost proportionally reduces.
- Environmental friendly with low CO_2 emission and no use of Mercury.
- Works at wide range of temperatures including very low temperature.
- No sensitivity towards humidity.
- Instant switch on/off.
- No effect on life due to frequent switching on/off.
- Durable towards vibrations and shocks
- Long life and low maintenance.
- Very low heat generation, more than 25 times less than incandescent lamps and close to 10 times less than CFLs.

In a recent project for a sister concern of CRP, we replaced the metal halide fittings with LED fittings. Though cost of the fittings was almost 2.5 times, it reduced the energy cost by half and doubled the illumination.

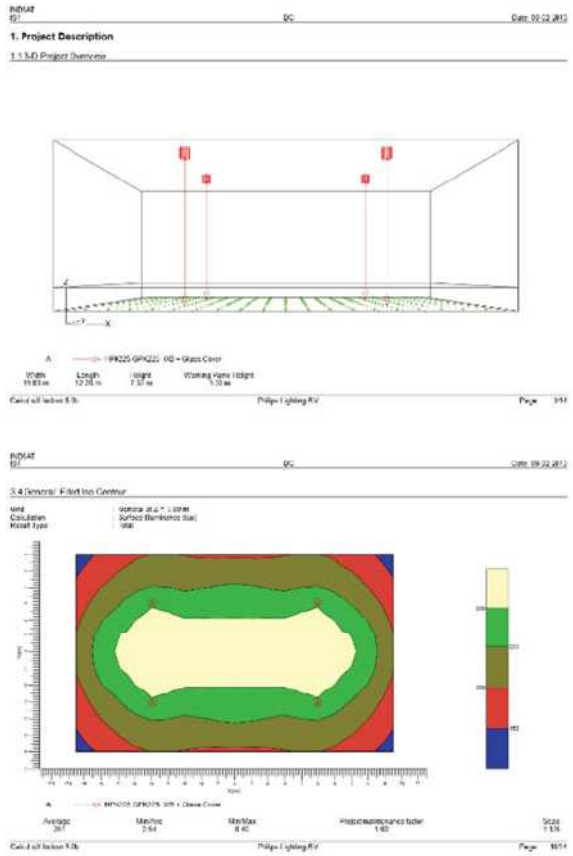

Figure 8 – Proposed 3D-layout with location of fittings (top) and ISO contours of light distribution (bottom).

Again for this project, the same software tools were used to compare the traditional and LED options in terms of layout and economy.

It is time for all our shop floors are illuminated with LED lights, saving energy and cost.

Conclusion

This is testing time for the economy the world over and it is important for all the organizations to look inwards in terms of saving cost and stay competitive.

The purpose of this paper is to rekindle the fellow die casters to look for energy saving opportunities.

Energy conservation is the key as die casting is an energy intensive sector. By saving energy, this sector not only saves cost but also gives an immense value to the corporate social responsibility and mitigates so much of damage already done to the environment.