



INTERVIEW

# DON'T UNDERSTIMATE COOLING

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## Technology Interview

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The importance and impact of cooling in high performance IML applications. An interview with two technology leaders.

Frigel asked a few questions concerning IML applications to its partners, which subsequently led to the creation of this interview.



## THE COMPANIES

**Frigel Group (the interviewer)** is manufacturer of cooling systems, portable chillers and temperature control units since 1960. We are technical consultants with the ability to identify the best solutions, in terms of performance, efficiency and environmental impact.

**StackTeck** is a Global provider of sophisticated integrated plastic mold solutions for the injection molding industry.

**Avance Industrial** is one of the machinery distributors serving the plastics industry with the longest presence in Mexico. They not only sell equipment, they provide technical consultants for injection molding machinery and peripheral equipment.



## THE TECHNOLOGY

**IML (In Mold Labeling) technology** is the most innovative labeling process for plastic technology. The procedure is complex: the graphic is pre-printed in a thin layer, the label is inserted into the cavity with an automation system, the plastic is injected over the label.

The result is a component with the label already attached, this will give a more sophisticated look to the container and will reduce the production steps.



## Q1— Cooling in IML applications. What are the challenges from a mold design standpoint? How much does cooling represent of the overall cycle time?

**Christopher Day, General Sales Manager LA-TAM at StackTeck:** Cooling is a critical part in thin wall molding. In mold design our challenge is such that we need to cool the molten resin the fastest possible way yet allow the resin to flow into the cavity to fill the part and pack it. The latter requires high injection pressure and speeds to allow the resin to flow into the cavity and not “freeze-off”, hence the need for packaging machines with accurate metering, shot to shot consistency, high speed & high pressure, and accumulator assistance.

Although IML thin wall parts are “thin”, fast cycle times are possible only if we can cool the part almost instantaneously & effectively to allow a proper demolding of the part with good part quality attributes. Cooling time on thin wall molds is a relatively small percentage on the overall cycle time. Yet to extract the heat from the steel molding surface you also need good cooling line design around the molding surface and best possible steel material selection for best thermal conductivity at your hottest or cycle limitation part design. But for

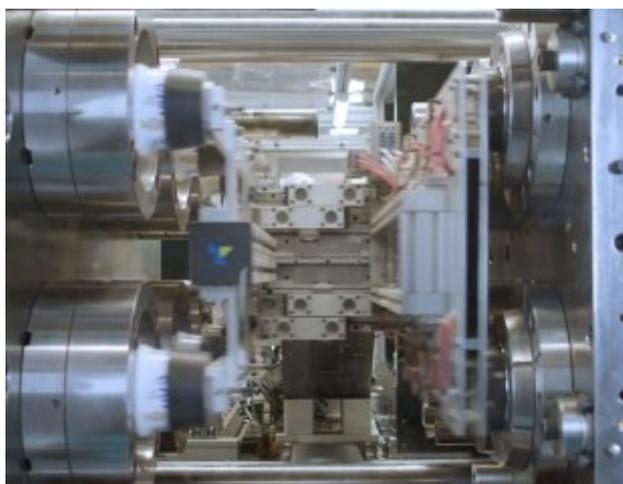
these cooling lines to be effective, turbulent flow is also needed achieved by high GPM rates to allow efficient heat extraction throughout the entire mold cooling layout across all the cavities. Laminar flow caused by poor GPM rates will hinder your mold cooling and part quality.

Hence the mold requires consistent cooling, high GPM rate, turbulent flow, and constant temperature set point. Cooling variation due to neighboring systems using the same cooling system will affect process and part quality. Therefore, a dedicated chiller at the mold is recommended.

**Alex Kramer, Technical Director at Avance Industrial:** IML Cell involves high speed machine and robot, as well as high technology mold. It is important to choose adequately the cooling system that will not be the bottleneck of the cell and limit the productivity. That means the main challenge for the cooling system is to provide the right cooling capacity, flow rate and temperature stability to maximize the productivity of the whole cell.

## Q2— How does cooling influence process optimization? How does flow rate affect the process? How sensitive is the process to cooling variations?

**C. Day, StackTeck:** Once a mold goes through its *FAT (Factory Acceptance Test)* and samples are dimensionally approved, the system has a locked-in process window from which, if the process varies outside this window, part quality and cycle may be affected. If all parameters are kept within this tolerance window, you will have a solid process and part quality. Possible scenarios falling outside this window are issues with under packed parts, sizes, flash, weight, cycle time, etc.





Focusing on cooling within this tolerance window, it is essential to maintain consistency in flow rate, temperature and pressure loss across the mold. Should the cooling system be affected by outside factors, such as ambient temperature, flow rate, water temperature, etc., part quality and cycle time will be affected.

Colder water does not necessarily improve your cycle time or heat transfer rates. In fact, colder water reduces chiller refrigeration capacities. Turbulent flow is the key point, as turbulence in the mold water channels is what extracts the heat from the steel more effectively than laminar flow which has a detrimental effect, as the water is flowing through the middle section and the water near the surfaces is almost static and does not mix with the water flow towards the middle of the water channel.

Process stability and repeatability, as mentioned before, is very important. Thin wall molds are accurately machined molds with very tight tolerances. If the IMM does not deliver shot-to-shot consistency, the mold will reflect this as a defect in the part with either short shot, flash, under packing, showing up on the molded sample parts creating the false impression it's a mold issue. Cooling inconsistency will affect part quality across the matrix of the mold also creating the false impression there is something wrong with the mold

or that is unbalanced when the issue is an imbalance of cooling throughout the mold.

**A. Kramer, Avance Industrial:** The vast majority of IML molds are thin wall. Usually, for thin wall parts, it is very important to have high flow rate, high pressure available at the mold and temperature stability throughout the whole production shift. If one of these three parameters change, there might be quality problems that can cause scrap or it might halt the IML cell.

Most of the time a central cooling system is not able to maintain these 3 parameters stable because it is influenced by the other IMMs in the plant. The *Microgel* is able to isolate the cell from the rest of the machines in the factory, giving the stability that will allow the IML cell to run with no problems.

The cell is very sensitive. Any cooling variation may cause quality and productivity problems. If the customer does not have a reliable cooling system, usually the cell has to be set up with the worst-case scenario to avoid any stopping. This means to reduce the velocity and the productivity, so the cooling system becomes the bottleneck of the IML cell. That is why having a reliable cooling system is vital for having the cell working at the highest velocity.

### **Q3— Water quality and mold performance. Critical aspects of the IML mold design in respect to water characteristics, maintenance and performance over time.**

**C. Day, StackTeck:** Water quality: why is it important? Over time, should the water treatment not be appropriate, it can begin to cause accumulation of deposit on the inside walls of the water channel. This accumulation on the walls begins to affect the thermal conduc-

tivity or heat transfer between the steel and the turbulent water, thus reducing the effectiveness to cool the part. Eventually this will begin to affect your process requiring the processor to add additional cooling time to the process to overcome the loss. Depending on where the accumulation occurs, it could also affect particular part quality issues on particular zones, forcing the processor to begin changes to his process, potentially moving him further out of the “process window” set from the original *FAT*.

As well, an adequate and approved water chemical should be used such that it does not affect the life of the steel and accelerate corrosion, cause erosion, or deposits on the water channel walls. It’s important to maintain your water quality to ensure constant medium to long term process conditions and allow the system to work in the same manner as it did when the mold was first started up.

**A. Kramer, Avance Industrial:** Each IML cell is composed by state of art machinery, it is unthinkable to have bad water quality that might compromise the functionality and the performance. Having good water quality is a must, and an *Ecodry system* is the best solution to have an impeccable quality of the water that will ensure mold longevity and high performances with minimal effort.

## Q4— What’s your recommended take away point?

**C. Day, StackTeck:** From my personal experience I have several:

- Design the water system around the engineered mold design cooling requirements: flow rates requested by the mold maker: GPM, pressure IN/OUT, and temperature.
- Dedicating units beside each mold prevents fluctuations caused by other systems, plant growth, etc.
- Never restrict the water lines coming from chiller to the mold with incorrect hoses,

fittings, etc.

- Frigel units, with the allowance to split flow rates and temperatures between moving and stationary sides, is a nice plus allowing operators greater processing options.
- Proper maintenance of water quality to prevent corrosion and deposits saves money on mold maintenance care, scrap and production inefficiencies.

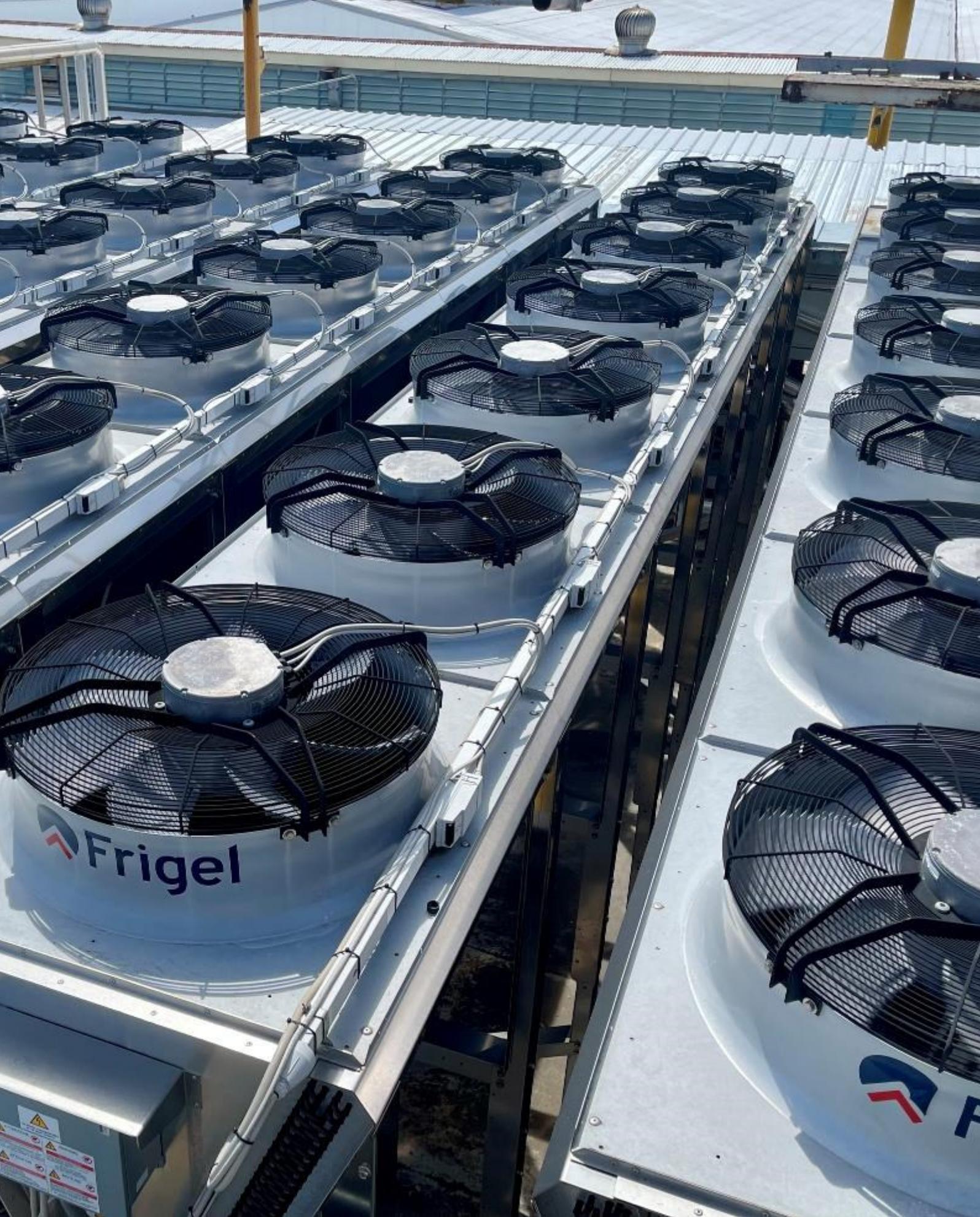
**A. Kramer, Avance Industrial:** As discussed earlier, there are 3 parameters that must be considered for each IML cell:

1. High flow to the mold. Usually this parameter is given by the mold makers and should not be neglected.
2. Enough pressure available at the mold to overcome the delta P of the mold itself. Also, this data is given by the mold makers.
3. Temperature stable with no variation over the production shifts.

The Microgel is the only machine that can provide these three parameters with no variation over time.



Microgel - RSD



#### **ABOUT FRIGEL**

Established in 1960, today Frigel is a global manufacturer of cooling and temperature control systems with 8 production sites and 51 distribution service points in the world.