

Refrigerators, Always a Cool Business!

INNOVATIVE SOLUTIONS, RELIABLE EQUIPMENT AND WORLDWIDE COVERAGE: THESE ARE THE THREE MAJOR REASONS FOR CANNON SUCCESS IN REFRIGERATOR MANUFACTURING. WE HEAR FROM PIERO CORRADI, CORPORATE DIRECTOR PLASTICS DIVISION, AND ANDREA ORLANDINI, THE CANNON GLOBAL PRODUCT MANAGER IN CHARGE OF THIS STRATEGIC MARKET, WHICH ARE THE LATEST NEWS FOR THE COLD WHITE APPLIANCES FIELD.



Cannon News: The basic matters first: which are the current trends in the refrigerators industry?

Piero Corradi: Increase productivity, optimise insulation costs, reduce gas emissions, use only environmentally-acceptable blowing agents. I could summarise all what the industry is looking for with these four targets.

CN: How is Cannon facing these requests?

PC: Delivering innovative equipment and performing production methods, as we have done for the past 50 years. We must work hand-in-hand with the Raw Material Suppliers, because all the above needs are satisfied by an innovative chemistry.

We can only design the tools that transform liquid formulations into high-quality foams in the best possible way.

CN: How is this chemistry evolving, then, and what is Cannon supplying to make it work efficiently?

PC: Without detailing the strategies of each Raw Material Supplier that cooperates with us, we can resume the latest trends as follows:

- Increase the efficiency of the insulation media working on the size and shape of the foam cells,
- Optimise the use of chemicals, trying to achieve a more uniform distribution of foam density within the walls,
- Reduce the curing time of the foam using fast-reacting formulations.

All the chemical leaders follow these three paths. There are now three types of formulations that can be taken in consideration to reach those targets:

- **Microcellular foam cells**, with diameter around 8-10 micron, that are under development using Aerogels and other innovative approaches. These foams might be industrially available in less than 3 years.
- **Foams with small cells**, with diameter around 100 micron, that are commonly available, are very reactive and thus require a very fast injection. They could already be used for a "100-second demoulding" goal.
- **Conventional formulations**, with 200 micron cells: they are the most economic, so far, but cannot provide a fast demoulding performance.

CN: What is Cannon doing for these three types of formulations?

PC: For the **microcellular foam project** Cannon Afros is the partner of **Dow Italia**, a leading science and technology global company, and **Whirlpool**, the appliance-white goods global company, in the **LIFE+ Project K-12**, aiming to demonstrate and show-case an innovative refrigeration technology to significantly improve the energy efficiency and reduce the carbon footprint of the Cold Appliance industry.

The K-12 project connects new chemistry with technology innovations, avoiding any use of Green

House Gases as blowing agents with a new appliance production technology driven by reducing the carbon footprint of manufacturing operations, addressing any technology requirements and regional needs. The 36-month project objective is **to bring radical innovation** to the manufacturing process of household appliances, insulated by a **microcellular high-efficient Polyurethane foam able to achieve about 30% reduction of thermal conductivity**, thus significantly improve the energy consumption of refrigerators and freezers.



CN: A classic R&D project then, with mid-term expected results. How about today's requests for an increased productivity?

PC: Since the chemical solution is a fast-reacting foam, the mechanical answer to that is a machine with higher output, to deliver several kilograms of liquid in very few seconds, and a combination of mixing heads able to fill in the most rational way the fridge's wall cavity. We provide 200-kg/min or larger high-pressure dosing units, connected with a new generation of mixing heads that provide a very laminar flow at high output rates. This generates a very homogeneous foam structure, free from air traps or voids. Our control allows for a double injection at different output in extremely fast sequence, closing only the tiniest of the internal chambers of the head. By playing with this possibility, and by splitting very precisely the flow of liquid components into two mixing heads **we can supply a four-head injection configuration using only two metering machines**. This reduces the investment budget, the operative and maintenance costs and the footprint of the dosing equipment in the plant.

CN: What is the Cannon answer to the production needs of a fridge manufacturer using conventional formulations?

Andrea Orlandini: There are other tools that we can utilise to increase productivity, even for conventional foams. We can play on the dry side of the plant, speeding up operations to provide a faster part-to-part production cadence. This is true for both cabinet and door foaming equipment.

We just released another innovative foaming system designed for customers requiring a compact industrial solution. It's derived from the famous Drum, that Cannon invented in the early 1980's, has been manufactured in thousands of units... and has been made also by several competitors, when its Patent expired! The Drum is a rotating polymerisation machine that features a structure composed by several sides, from three to twelve, holding the moulds. These moulds have always been filled with foam when they are parallel to the floor, fixed horizontally on the sides of the structure. We have now developed another method for foaming the doors, the **VertiDrum**, where the foam rises vertically and the advantages are numerous:

- With only two units and a conventional rigid formulation two complete sets of doors can be extracted every 30 seconds: **it's the**



same productivity of a fast Paternoster system, on one fifth of its footprint, only 3 by 2 m each Drum, with access on the 4 sides.

- The foam rises vertically in the door cavity, with a positive effect on the thermal insulation: the elongated cell's structure produces more cells within the thickness of the door than those obtained when foaming it horizontally, and placing more cells (thus more obstacles) in the direction of the heat transfer **improves the Lambda value - the insulation capacity - of the door.**
- All the air contained in the door cavity is rushed out through the narrow top side of the mould, avoiding any risk of air entrapment on one of the two aesthetic sides: **The same good quality is available on both side of the door** regardless of the way it is loaded into the mould. No more issues about plastic liner on top or bottom side, we talk now about left and right side.
- The **distribution of densities within the foam is optimal**, with a maximum difference of 0.5 kg/m^3 between the heaviest and the lightest sample. **This saves a lot of foam**, at the end of the year! The VertiDrum is a real breakthrough in the industry especially when the reactivity of the foam is high and when the door shall contain additional inserts, moreover it can also be used for any kind of thin, rectangular insulating panel.

We just applied for some patents regarding a **new production solution** based on **free-riding** moulds running in a track where they are kept closed, during the polymerisation period, by a continuous series of steel rolls mounted on rails.

The line is conceived with a number of service stations, an injection point and a polymerisation area. Each station is dedicated to only one simple action that can be executed in very few seconds. Initially designed for a given polymerisation time, when the chemistry will allow for faster production cycles the line can be adapted simply removing a few polymerisation stations. Mould change can be performed in a dedicated station during the cycle time, without stopping or delaying the production. Fast, flexible, simple... the new system is now going into production at Electrolux Mexico in their Ciudad Juarez factory, and we are constructing another plant for delivery by the end of this year.

CN: Several news concerning the doors, it seems: anything new for the production of cabinets?

AO: No, nothing new in the past... 6 months, I'm afraid! For the cabinet production we are consolidating the supply of our **VAI (Vacuum Assisted Injection)** system which makes use of vacuum during the injection of the formulation and the expansion of the foam in the cabinet's wall cavities. This method provides a quick demoulding time, improved thermal insulation capacity, optimum adhesion of the foam to the metal structure and lower consumption of energy during the cabinet's life.

We built to perfection the **VAI version of a RotoPlug 2** foaming fixture, that allows for a model change in Zero-Time: when one size of cabinet has to be temporarily replaced by another in the foaming process, the rectangular platform holding the male plugs, on the upper side of the station, rotates by 180 degrees. The new male plug, already thermally conditioned to the correct temperature, is brought on the lower position of the platform, ready to start its cycle of foaming processes. The plug going off-duty is sent on the upper side of the platform, where it can wait for its new cycle of injections or it can be manually replaced or adapted to a new cabinet design.

The adjustment operation on the upper plug can be executed while the lower plug is regularly producing. The major advantage of this system derives from the increased flexibility guaranteed to its users: a very small production series of a given model can be easily inserted with a very short notice without perturbing the output cadence. Stocks of finished cabinets can be dramatically reduced, since it's no more necessary to produce numerous units of each model only to justify the loss of time deriving from a mould change operation.

And to finish with the innovation on cabinets, we **supplied to Fisher & Paykel Thailand the RotoJig**, a foaming station with a rotating platform that holds two fully-functioning polymerisation jigs, in its original **VAI configuration, to work with vacuum**. The service operations occur at the lower level, while foam injection and polymerisation are performed at the upper.

This innovative design allows for both types of foam injection: it can be used with face-down refrigerators with multiple heads on the top, or with single injection from the compressor side, made on the lower position of the RotoJig. Double productivity per meter square of factory! The rational design of our VAI foaming plant, including loading and unloading fast system and the mechanics of the jig have been so appreciated that we are asked to apply the same concept even for non-VAI production methods!

「The Cannon RotoJig is a foaming station with a rotating platform that holds two fully-functioning polymerisation jigs. It can be supplied in a configuration suitable to work with VAI (Vacuum Assisted Injection).」





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recent formulations. Its design is derived from the famous FPL model, the L-shaped mixing head patented by Cannon in 1979. The mixing chamber's geometry has been maintained, while the larger of the two hydraulically-operated plungers has been replaced by a very short piston of very narrow diameter, that leaves a tiny amount of chemicals to clean at the end of the shot in the specially designed spray tip, an operation performed with compressed air.

Numerous advantages derive from this design, and from the accurate set up of the rest of the equipment that has been executed in Cannon R&D facilities in cooperation with the major Raw Material Suppliers involved in this sector of the Automotive interior's market:

- The distribution of chemicals occurs exploiting the kinetic energy generated by the pressure impingement system, thus it's totally an **airless method**: contrary to air-propelled application methods used by other suppliers,

the Cannon solution provides a neat flow of pulverised formulation, totally **free from mist**. The final blow of air cleaning the spray tip occurs over the part itself, without generating at the end of the shift a bag of scrap foam that would need special disposal precautions. The effect on the working environment is stunning: moulds, robots, floors and the surrounding equipment stay clean much longer; there is a reduced need for fumes treatment, the working hall is in general terms **more workers-friendly** and a significant quantity of **chemicals is saved** at the end of the day.

- The **spray pattern** is characterised by a regular, triangular, 2D shape that, contrary to a conic pattern, distributes the chemicals precisely where they are required, avoiding any overspray between contiguous passes: this translates into a lower number of passes to cover a large mould, with much better distribution of densities, possible deposition of more material only where it is desired and an **overall gain in cycle time**, versus other competing methods, that can be quantified in **around 20%**.
- Customers demanding a **wide spectrum of output** to the dispensing unit and to the head can be satisfied: the dosing machine and the LS10 mixing head can work – with the same set of injectors! – **from 30 to 300 g/s**. If the design of the part to be produced allows for it, a very fast sequence of few passes, executed at high output (or working at normal output while reducing the speed of the robot) covers the entire surface of a luggage compartment floor for a large automobile with a **part-to-part cycle as short as only 40 seconds**.
- Customers using different chemical **formulations (normal or filled with mineral charges)** can do that using the same standard configuration of Cannon equipment: the whole set of parts in contact with the Polyol side is thermally hardened and treated against the abrasion.
- This simplified **design of the mixing head** converts into a very compact construction, with fewer hydraulic pipes, suitable for an automated application **using commercial robots of medium-small sizes**, that are not capital-intensive to buy and maintain.

Numerous manufacturers of car parts in Europe, China and the USA use the latest JetPreg solutions to produce light Polyurethane-reinforced structures made with honeycombs.

Numerous automotive parts manufacturers in Europe, China and the USA, are using the latest configuration of Cannon **JetPreg** solutions to mass-produce Polyurethane reinforced, lightweight structures: contact the nearest Cannon Local Office and find a solution for your next honeycomb project!

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Cannon Chinese Technicians Meet

CANNON AFROS, CANNON FAR EAST AND SHINNON HELD A JOINT THREE-DAY TECHNICAL MEETING IN SHANGHAI IN MARCH 2016. THE LATEST TECHNICAL DEVELOPMENTS OF THE CANNON METERING AND MIXING TECHNOLOGIES WERE ILLUSTRATED TO 33 CHINESE ENGINEERS FROM 3 COLLEAGUES FROM CANNON AFROS.

The Chinese engineers came from the Cannon Far East Offices of Singapore, Shanghai, Taiwan and from the Shinnon factory in Zhongshan. During these days (21 - 23 March, 2016) they discussed about the new technical development concerning the mixing heads' new functions and maintenance procedures, as well as the most recent solutions for the Pentane-conversion of existing foaming plants. All the attendants had an hand-on experience as to the maintenance of the different types of mix heads.

During these three days they also discussed the most common technical problem faced in the Far East and shared with the Italian colleagues some of the latest solutions developed to solve them.

This Technical Meeting, which is being held annually, is an extremely useful occasion not only to transfer the latest developments from the Manufacturing Centres to field engineers but also to create a teamwork atmosphere between the various Units that mostly keep alive the personal relationship of Cannon with its clients.

