NEXUS KNOW-HOW

The technology used by Evolution Aqua to produce their Nexus and Eazy units has not only increased production but also saves energy and creates almost no waste – **Jasper Kuijper** explains how rotor moulding has transformed their world…

Jasper Kuijper

Jasper Kuijper has been a Koi keeper for more then 20 years. He now works for Evolution Aqua as their commercial director and was the man responsible for designing the revolutionary Nexus and Eazy Pod filters that are so popular today.

One of the changes to the Nexus was a new grill (kiss-point arrangement) to improve the flow between the two tanks and to prevent media passing between them (see old arrangement below)

The efficiency of the machine is astounding: the waste produced during production of an Eazy Pod is just 0.1%

When the Answer was built and designed by Nick Jackson, there was a high demand for stainless-steel tanks to hold these Answer units. At the time these tanks were very popular but the price was far too high for the mass market. Nick is a very good friend of mine and in 2002 I started working for Evolution Aqua. One of the most important jobs I had was to replace these stainless-steel tanks with a plastic version; I was also looking for a way of incorporating the existing and proven **Kaldnes moving-bed** technology. We tested our designs at our facility and the results were very good compared to Japanese matting – we now needed a new tank that could hold the Answer and a Kaldnes moving bed. This sounds easy but our aim was to create a very small and efficient unit, which was much harder than we first thought.

We started working with **rotor-moulding** designer Keith Rick to get the first mould design. It was a huge challenge to get the first design for the Nexus 300 right – to give you an idea we had to make 85 units before one was good enough. The most difficult part was to get a good wall thickness in the centre tank of the Nexus which holds the Answer or foam block. A year later we created the Nexus 200 and made significant improvements.

Then we designed the Eazy for the Nexus unit. The main reason for this design was to reduce the amount of energy the Answer was consuming and to improve particle capture. What most people forget is that waste particles are very soft and easily break up into smaller parts. In the Eazy we use a caking principle – a means by which the soft particles lose their energy every time they hit a rib on the outside of the **K1 media**. The Eazy actually works in the same way as a bead filter on the outside of the K1 media and like a biological filter on the inside: in this way you have the benefit of two methods. Cleaning is done by aerating the media so the water column in the centre is higher than on the outside of the metal container. This method pushes the dirt to the outside of the Eazy so it can be easily washed away to the sump. This was so simple and successful that we had to look at a way of increasing production – this was not so simple as it was difficult for the contract moulder to increase its production volume.

Out of control

In the industry they say that rotor moulding is a black art. This means that they don't know how to get the process under control – and this was something I wasn't willing to accept. So I looked around to see if there was new technology available. In the end I found an Italian company called Persico which had a new technology called 'Leonardo'. After visiting them with our existing contract moulder they said straight

PRODUCTION CAPACITY

36 Nexus 300 units a day

48 Nexus 200 units a day

80 Eazy Pod units a day

PRODUCTION CYCLE OF THE NEXUS 300

STAGE ONE
Once the machine has finished rotating, the Nexus unit is cooled down to a temperature of 60˚C outside and 90˚C inside

STAGE TWO
The mould is then held in place by three pins at the top while five active vacuum release valves enable the automatic de-moulding process

The red arm of the tool rotates in two different directions to evenly distribute the powder used to create these units

The old production method for the Nexus units was outdated – it involved inserting the mould into a gas oven

JARGON BUSTER

Kaldnes moving beds are filter bays in which the media contained within them is moved by air – they were designed by Professor Hallvard Odegaard. 'Anoxkaldnes' is the manufacture of different types of media for waste-water treatment plants, breweries, pulp-waste treatments, aquaculture and other applications – and this is the best documented process for treating water. Evolution Aqua now holds the world licence to use this process for aquatics and aquaculture applications.

Rotor moulding is a polymer-moulding process that is used to make hollow parts. A polymer material is inserted into a hollow mould cavity that then rotates in two perpendicular axes; the mould is also heated. This heating and rotation of the machine melts and evenly distributes the material on the inner surface of the mould to form a 'part'. The mould is then cooled to solidify that part for removal.

K1 media is a negative-charge biocarrier that holds a healthy biofilm inside that biocarrier – this is called the protective surface area. This protective surface area is the most important aspect you need to consider when discussing the efficiency of today's biofilters.

Polymers are compounds formed by the reaction of simple molecules that allow those molecules to bond together to form long-chain molecules. This takes place under suitable reaction conditions and typically in the presence of a catalyst – a substance that increases the rate of a chemical reaction without itself suffering any permanent physical change.

Melt index is the amount of thermoplastic polymer that will flow through an orifice, specified as 0.135in long x 0.0825in in diameter (3.43mm x 2.1mm diameter), under specified conditions of temperature and pressure. It is expressed in grams per 10 minutes. Polyethylene is normally tested at 190˚C with a weight of 2.16kg.

Hoppers are funnel-shaped reservoirs from which solid materials can be discharged into a receptacle below.

Z-axis is the third dimension in space (x, y, z) – in this example it means that the float switch can move up and down inside the unit by 13cm.

away that Persico could not make production fully automatic. Of course, I understood their point of view, but I could also see the potential of their production method to solve our quality issues. After many discussions we decided to go ahead and design a new machine to make the Nexus units and the new Eazy Pod.

This was a very big challenge because the goal was to make this process fully automatic using automotive standards. We had to redesign the Nexus units completely and this was my last chance to improve the units for customers. The first improvement was to the 'kiss points' that act like a grill between the two tanks and stop the K1 going back into the first tank. This has always been a weak point because it's been difficult to get enough wall thickness at that point. Using 'equal heating' I was able to solve this and make a horizontal long grill that would decrease the head difference between the two tanks when using a strong circulation pump. Because of the new kiss-point arrangement there are no more holes in the first tank that could create dead spots for debris. The second improvement was to the volume of the biochamber – we managed to increase this by almost 14% without making the footprint bigger. The advantage of this is that if a Koi keeper wants to increase the size of their collection, they can do so by putting more media in the outside chamber without investing in bigger filters. The third improvement was to the outside grill which has now been made much wider to stop the K1 bulging when the flow is too high.

It took around two months before the new Nexus designs where ready. The Eazy Pod was a not an easy task either because the stainless-steel screen inside this unit is fixed to the plastic without using screws. To achieve this, the centre of the Eazy Pod needed to be open so that the screen could be pushed in – and for this we needed to use a special material that created this opening during the rotor moulding. The design criteria for this product also involved reducing the amount of waste to an absolute minimum. All in all, the Eazy Pod took around one-a-half months to design.

After finishing the designs we began work on the new machine, which involved a very big team of engineers led by Lorenzo Bergamo.

The new process

When creating a Nexus or Eazy we start with a **polymer** that is specially made for our use – three different colours at different grain sizes that vary between 200 and 600microns with a specific **melt index**. The powder comes in 1,100kg bags and is loaded by vacuum into a **hopper** that has a very sensitive weight sensor so we can load exactly 44kg. The mould is then loaded with the exact amount of powder; each moulding has a loading accuracy ▸

STAGE THREE
The de-moulding table then moves towards the machine to pick up the Nexus 300 unit

STAGE FOUR
The three de-moulding pins are then released and the valves push the Nexus 300 out of the mould onto the de-moulding table

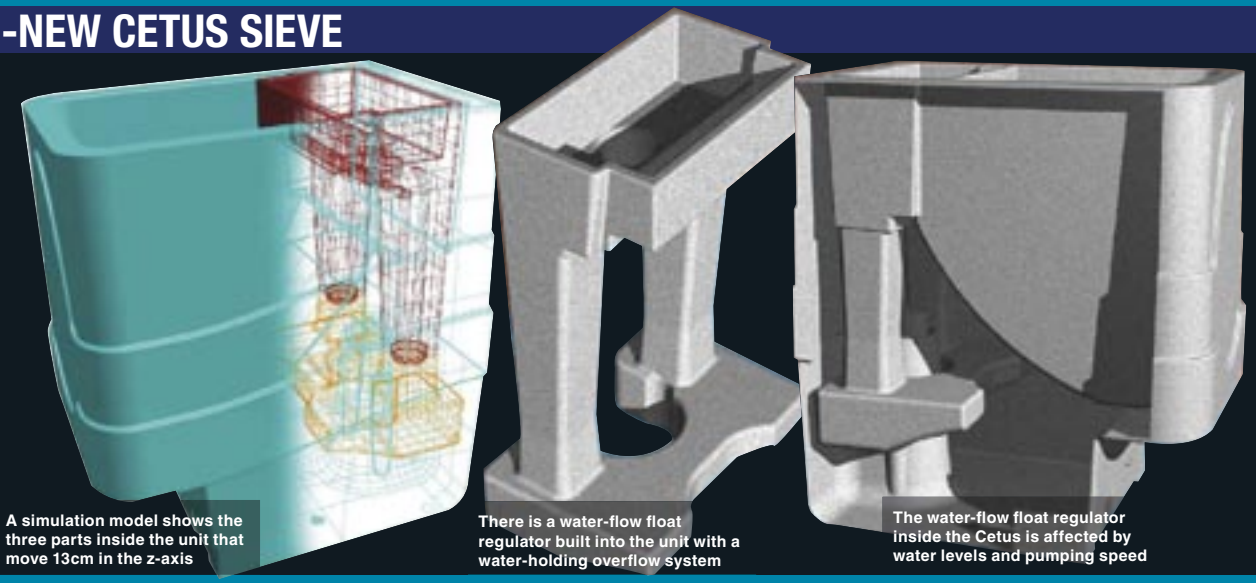
STAGE FIVE
The Nexus 300 is now around 60˚C and is transported to the slide for final assembly

This machine is fully automated and can produce up to 36 Nexus 300 units in one day when demand is at its highest

An oil circuit is used to heat up the mould to a maximum temperature of 165˚C and is then cooled down towards the end of the cycle

THE BRAND-NEW CETUS SIEVE

The Cetus has a deep core which was only made possible by the equal heating involved in rotor-moulding technology. This also meant the Cetus could be made more rigid and functional than before. Another advantage is a true 200 or 300micron screen that is part of the overflow built into this unit. The waste-capture area is modelled in such a way that the waste can be collected more effectively and guided direct to a bigger drain.



A simulation model shows the three parts inside the unit that move 13cm in the z-axis

There is a water-flow float regulator built into the unit with a water-holding overflow system

The water-flow float regulator inside the Cetus is affected by water levels and pumping speed

▸ of 10g. Then we close the mould and rotate it at 8rpm in one direction and 2rpm in the other. At the same time we heat the mould with a hot-oil circuit up to 165˚C. The powder becomes liquid and forms a crystallised layer from the outside in, until all the plastic solidifies. When the heat is equal, the wall thickness is equal. When it has reached the maximum temperature inside, we cool the unit with 1 ton of water at 11˚C through a heat exchanger which cools down the oil circuit. When the mould has reached an outside temperature of 90˚C we stop the rotation. At 60˚C we open the mould, which was probably one of the biggest challenges – with the old method we used wooden sticks to get the mould out but now it is fully automatic. At first we tried using three pins at the bottom of the Nexus unit to keep the mould on top in place so we could 'de-mould'. But this was not enough: it ripped the mould to pieces because the vacuum created in the centre of the Nexus was so high. Now we use active vacuum valves that create a pressure in the vacuum area so that de-moulding can be fully automatic. After this it is picked up by a loading and de-moulding table that pushes the Nexus off for final assembly. Assembly is achieved in less than 15 minutes. After a final quality inspection the unit goes into a box, and this box can end up in one of the 50 countries that we supply to around the world.

Future developments

Our next product is already in production – a new sieve called 'Cetus'. Cetus is the Latin name for a whale that filters out algae. This product has been on the drawing board for a long time but could only be made with the new rotor-moulding technology. The reason for this is that the core of Cetus is very deep and narrow and it is a challenge to get the heat right inside it. Besides this, there are three parts inside the machine that interact with each other to enable a 13cm movement in the **z-axis**. We had to use simulation software to find out if this would work before we could start making the mould. The advantage of the Cetus is that it uses a 200 or 300micron screen. And, more importantly, there is a bigger waste drain and collection area that guides the waste to the drain through all the curves. This unit can now overflow without drying out the pump. Another advantage is that this unit can be used in pump-fed applications. We are also planning a special Nexus unit for swimming ponds and pools, which are becoming more popular.

Conclusion

It has taken 18 months from start to finish, and a two-month stay in Italy, to create this fantastic machine that has raised the quality standards for this industry to its highest levels yet. To give you an example, the waste for the Eazy Pod is less than 0.1% and this is unheard of in this industry. We now have the best production method to create a high-quality filter for our customers. Rotor moulding is not a black art any more and has become a really controlled process. ■

PRODUCTION TIMES FOR NEXUS AND EAZY POD MODELS

MODEL	OLD PRODUCTION TIME	NEW PRODUCTION TIME
NEXUS 200	85 minutes; weight: 35kg	30 minutes; weight: 26kg
NEXUS 300	90 minutes; weight: 50kg	42 minutes; weight: 40kg
NEXUS EAZY POD	n/a	18 minutes; weight: 10kg