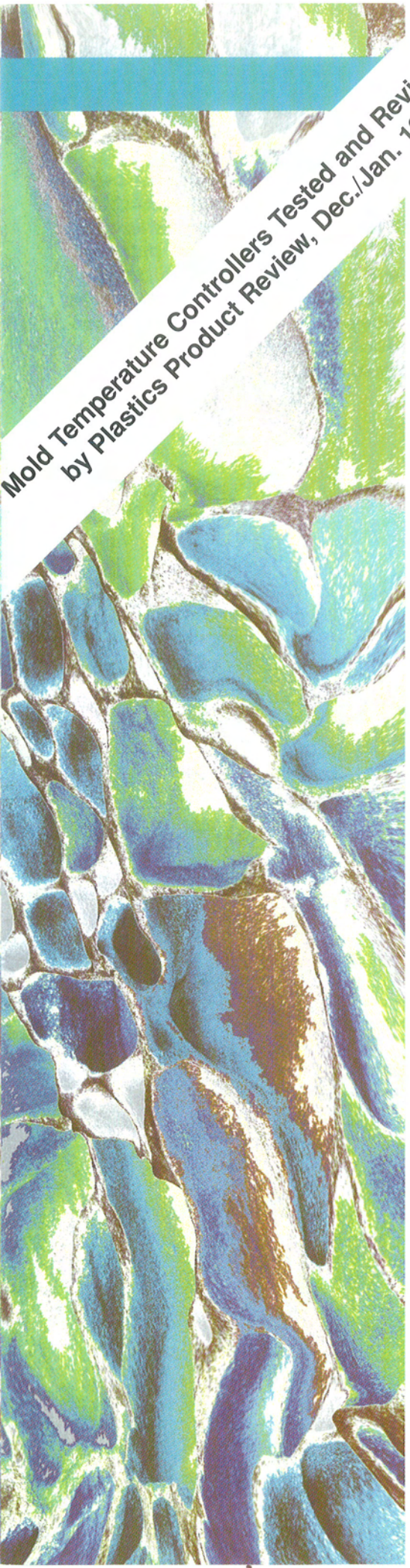

Mold Temperature Controllers Tested and Reviewed by Plastics Product Review, Dec./Jan. 1999

Hot Oil- Hot Molds- Hot Products

If Vikings had this product they would have installed even more fear on their opponents. Can you imagine Derek saying, "If you don't succumb we'll boil you in a bath of CIRCULATED hot oil."? Yeah, me either, but I didn't want to make another crummy joke about the weather in Traverse City, so I naturally thought, well... Vikings!

In this article we see who can sail away with the best oil temperature controller. The two competitors are Conair of Pittsburgh, PA and Mokon, of Buffalo, NY. For this test we attack high temperature units in the 1 H.P., 12 kW, 10 GPM range. Future issues will include more competitors, culminating in the Year in Review.

If you need a mold temperature above 200 degrees you are likely going to need a hot oil unit. Hot oil controllers work on the same basic principles as mold temperature controllers, but there are some key differences and problems created by the high temperatures. We'll see how well the controllers are able to overcome these problems and provide consistent flow and accurate temperatures. All of this at 400°F- almost twice the boiling point of water!

All of this at 400°F- almost twice the boiling point of water!

Test Results

Oil Temperature Consistency and Accuracy- For this test we measured the oil temperature over time and looked at the consistency. At the same time we recorded what the controller read as the oil temperature. PPR felt it would be interesting to see if there was any difference between the two. Mokon had less deviation in both oil and controller temperatures. Its controller temperature also recorded a temperature remarkably close to the set point. In contrast, the actual oil temperature taken in-line about three feet from the unit was about seven degrees higher. Conair's unit had a larger standard deviation, but the actual oil temperature was only two degrees from the set point.

Again we see a Mokon product test extremely well.

Flow Data- In this test we looked at flow consistency from mold to mold. Mokon's unit produces the most consistent flow we have seen! We have conducted this same test of the pump on eight mold temperature controllers and four

Conair uses their top-notch standard heat transfer controller on the hot oil units as well.

chillers, and we have not seen such superb results. Conair's flow data was at least average, but it did not fair well in direct comparison to the Mokon unit. We did have a problem getting the Mokon's pump primed initially due to trapped air in the system. After using the air purge feature a few times this problem was cleared and the test was started.

Speed of Heat Up and Cool Down- We test for speed with a hundred-degree swing in each direction (100 up, 100 down). Mokon's unit was faster in each case. Its speed of heat up was quite quick, coming in over twice as fast as the Conair unit. The Mokon oil temperature controller had about a twenty-degree overshoot for approximately two minutes while Conair stayed right at the temperature upon reaching it.

Energy Consumption- Mokon's unit was slightly more efficient over the thirty minute testing period. In comparison to other water products, it appears that oil temperature controllers use slightly more energy than chillers and standard mold temperature controllers.

General Notes- Both units were about the same physical size, but there was a large difference in the reservoir capacity. Conair's unit requires about 5 gallons of oil while Mokon's uses about 13. This shouldn't effect the performance in the closed loop systems, but rather depends on what you prefer and what your system requirements are. Initially, you will need to spend more on the Mokon unit (heat transfer fluid is about $10 per gallon), but you will not need to refill it as often as the Conair (assuming you have any sort of a leak). We do highly suggest you ensure that you don't have any leaks in your system. Hot liquid will cause third degree burns quickly! Conair uses the same controller on the hot oil unit as they do on their chillers and mold temperature controllers. Those who have read these articles know we are quite high on this controller for a multitude of reasons. Mokon uses a Barber Colman controller that offers a variety of built in features. Other than that, you have probably had experience with both third party and proprietary controllers so you know the general advantages and disadvantages of each.

Conclusions

This is the second Mokon product we have tested that has fared quite well. It has great flow consistency from mold to mold, energy efficiency, temperature consistency, and speed of heat up and cool down. The only drawbacks we saw were the temperature oscillations for a couple minutes at new set points and the seven-degree difference in measured oil temperature in relation to the measured controller temperature. Conair did not fair as well as Mokon in most categories, but they did have oil temperatures closer to the set point and excellent temperature consistency. Future testing will see where both units stand, but to this point we see the Mokon unit as a tough benchmark to beat with less than a degree of oil temperature deviation and the best flow consistency to date.

How We Test Oil Circulating Mold Temperature Controllers

What We Test

We conduct four main tests when evaluating an oil circulating mold temperature controller.

Flow And Pressure With 7 Different Molds- PPR tests this because molders often use a variety of molds with the same mold temperature controllers. We looked specifically at how well the mold temperature controller was able to repeat flow in gallons per minute. Flow is what you are looking for, the pressure drop is what causes the flow to occur. The less deviation in flow the better.

Speed Of Heat Up And Cool Down- For this test we look at the speed of oil temperature heat up and cool down. This is a performance aspect similar to seeing how fast your car can go.

Temperature Consistency- This is a test of the mold temperature controllers ability to keep stable temperatures in the oil. This is important because anything that can make your process more stable is valuable.

Energy Consumption- Energy consumption is measured in KWH. Variables such as temperature overshoot, oil temperature deviation, and anything else that might be detrimental to a stable process are also noted.

How We Test

Flow And Pressure With 7 Different Molds- For this test we use two Omega Engineering pressure gauges. In between these two pressure gauges we insert an area control device. This device uses a knob to adjust the area of the space through which the oil can flow. The knob is numbered from 0 to 9 so that changes will be consistent each and every time. This area control device is used to simulate seven different molds. By changing the area it simulates the different sizes of oil lines in different molds. We also place an Omega Flow Meter after the second pressure gauge. Testing is started with the largest flow area possible. Pressures and the flow rate are then recorded. The flow area is decreased and the process is repeated until seven different molds are simulated. Flow is the key variable. PPR is looking to see how well the mold temperature controller can repeat flow from mold to mold. Remember flow follows the following formula:

Flow=K (a constant) * Area * the square root of the change in pressure.

Therefore to keep flow consistent a larger pressure drop is needed to compensate for a smaller area. That is why we also measure the two pressures.

Speed Of Heat Up And Cool Down- The temperature setting is increased from 300 degrees Fahrenheit to 400 degrees Fahrenheit. Then we look at temperature thermocouples to see how long it takes the oil temperatures to come up to the set point. For the cool down portion we simply reverse the process.

Temperature Consistency- Using the thermocouple described above we look at the consistency of the oil temperature once a minute for thirty minutes. At the same time we also record the temperature exhibited by the controller over this same time period. The oil temperature is set at 400 degrees Fahrenheit for the duration of the test.

Energy Consumption- Energy consumption is measured in KWH for the "Temperature Consistency" test.

Hot Oil Test Results

	Mokon	Conair
Model Number	HTF 500	HTR1-500
Motor Horsepower	1	1
Heater kW	12	12
Flow (GPM)	10	10
Maximum Temperature	500	500
Price*	$6,330	$3,900
Speed of heat up from 300-400 (min.)	2:40	5:55
Speed of cool down from 400-300 (min.)	10:26	11:56

*Due to configuration

	Mokon	Conair
Oil Temp. Consistency & Accuracy		
Set Point 400°F		
Standard Dev.- Oil Temp.	0.792	1.389
Standard Dev.- Controller Reading	0.179	1.040
Average- Oil Temp.	407.19	398.00
Average- Controller Reading	400.03	400.76
Diff. from Set Point- Oil Temp.	7.19	2.00
Diff. from Set Point- Controller Reading	0.03	0.76
Flow Data on 7 Different Molds		
1 is Smallest-7 is Largest		
Mold 7		
Pressure 1 (psi)	30.00	23.00
Pressure 2 (psi)	20.00	15.00
Flow (gpm)	2.80	2.40
Mold 6		
Pressure 1 (psi)	36.00	23.00
Pressure 2 (psi)	20.00	15.00
Flow (gpm)	2.80	2.30
Mold 5		
Pressure 1 (psi)	40.00	24.00
Pressure 2 (psi)	18.00	10.00
Flow (gpm)	2.60	2.00
Mold 4		
Pressure 1 (psi)	44.00	24.00
Pressure 2 (psi)	18.00	8.00
Flow (gpm)	2.40	1.70
Mold 3		
Pressure 1 (psi)	46.00	25.00
Pressure 2 (psi)	15.00	8.00
Flow (gpm)	1.80	1.40
Mold 2		
Pressure 1 (psi)	54.00	26.00
Pressure 2 (psi)	10.00	5.00
Flow (gpm)	1.20	0.50
Mold 1		
Pressure 1 (psi)	56.00	26.00
Pressure 2 (psi)	5.00	5.00
Flow (gpm)	0.80	0.10
Total Flow Data		
St. Dev./Average	0.39	0.60
Range/Average	0.97	1.55
Average Percentage Change	18%	32%
Energy Consumption (KWH/per hr.)	0.640	0.804