

ProVac® VAMP, a novel system for process monitoring and product quality assurance

THE VAMP: PROCESS MONITORING ENSURES GOOD AND REPEATABLE QUALITY

The differences between the pressure measured at the valve or the chill vent and the all-important pressure inside the die cavity just before the metal enters are well known. Measuring the pressure in the die is normally extremely difficult, and it may significantly increase the costs of the process, so that in practice it is hardly ever done. VDS has solved this problem with a new advanced analysis system called the Vacuum Analysing and Monitoring Processor (VAMP) – and measuring die cavity pressure is not the only advantage it offers the die-caster.

1. THE VAMP - INTRODUCTION



The ProVac® VAMP is a microprocessor-supported deep level analysis and control tool for monitoring and optimising cavity evacuation. In addition it is a tool to help in diagnosing some general characteristics of the die-casting process.

The embedded computerized system is permanently connected to pressure sensors for high precision measurements and to a complete database consisting of laboratory-measured pressure curves.

The VAMP is used in relation with the Siemens or Allen-Bradley -CPU of the ProVac® PLC-250 controller for advanced analysis of vacuum-curves, suction capacity and pollution control, monitoring and determination of leaks in the die and in the shot sleeve.

Results of the VAMP analysis are stored both in the form of characteristic values giving in one view a summary of the main characteristics for the shot, and also in the form of complete evacuation curves. The user can log more than 20 years of operating results on the hard disk. Results can be reviewed easily to highlight improvements in quality or changes in the die-casting process.

Fig. 1. The ProVac® PLC-250-Plus controller, with the VAMP on its right door

2. THE VAMP - DETERMINING PRESSURE IN THE DIE WITHOUT AN EMBEDDED SENSOR

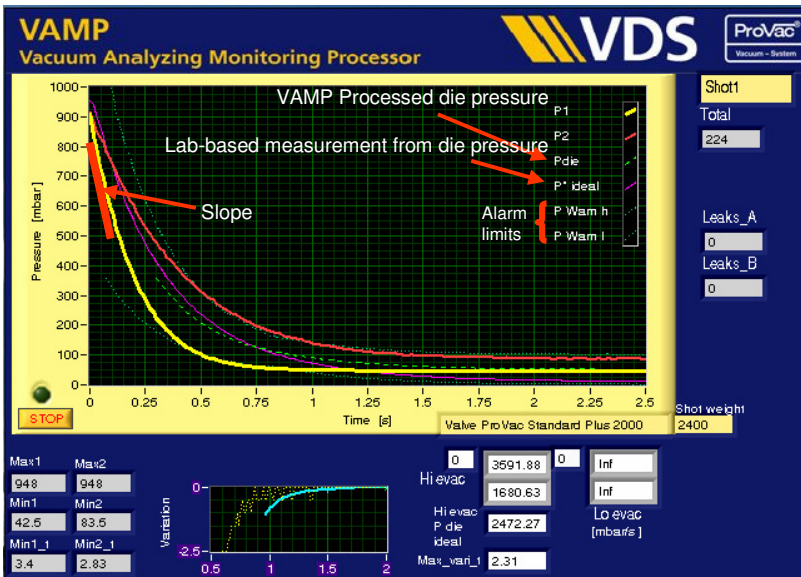
The VAMP does more than analysing and monitoring. In the heart of its main program there is a consistent database of laboratory-measured vacuum curves. This database was built up by making a comprehensive series of lab-tests, which make it possible to predict the die cavity pressure from that measured at the valve or the chill vent. The tests were carried out for all sizes of ProVac® valves and chill vents, and with or without vacuum channels, and for a variety of shot weights, and the relation between measured pressure and in-die pressure described mathematically with respect to each one of these parameters. The VAMP uses the database to predict the variation through time of the die cavity pressure from that of the measured pressure at the valve or the chill vent. The procedure is as follows:

- First the VAMP assumes that the vacuum runners have been cut into the die according to VDS recommendations, which means among other things that the critical evacuation section will be located not in the runners, but in the valve. If this is not so, then the evacuation speed will be lower by an indeterminate amount than that predicted from the database.
- The program calculates the prediction using the database and the mathematical relations.

- The validity of the prediction is verified by checking if the first derivative with respect to time of the measured pressure is plausible. This slope is related to the volume of gas to evacuate and to the leaks of the die and shot-sleeve. Were the vacuum runners for example to be closed by a jam, then this slope would be very much steeper than it could possibly be in relation to the shot-weight.
- A second validity test of the prediction is performed with determining the air-flow through the die (and with determining the evacuated volume of air per centisecond)

After each shot, the VAMP first screen appears, as typically shown in Figure 2, with the following curves :

- First the absolute pressure curves at the valve or chill vent for valve 1 (P1) (and for valve 2 (P2) if existing).
- “Pdie” is the pressure in the die derived from the measure P1 as explained above.



- “Pdie ideal” is the pressure in the die from a laboratory measurement (without leaks) with the same valve or chill and with the same shot-weight.
- “P_{warn h} and P_{warn l}” are the limit pressures before alarm (h and l are set for high and low speed evacuation zones)

The slope at the start of evacuation is used first to check leaks and second to check the plausibility of the measured P1-curve.

The VAMP displays in addition some useful key values giving the main characteristics of the evacuation at a glance.

Fig. 2. VAMP first shot-pattern. It shows among other things the predicted pressure in the die cavity, which is a vital indicator of quality in vacuum pressure die-casting

3. THE VAMP - MANY OTHER HELPFUL TOOLS

Many other features of the ProVac® Vacuum Analysing and Monitoring Processor can be very helpful for improving quality in die-casting. They are for example zooming on curves, overview of minima and history, determination of characteristic values (slopes etc.), alarms adjustable on different levels for optimal production monitoring, users’ “ideal curves” for comparison and alarms, monitoring of the leaks in the die and shot-sleeve, advanced checks of the evacuation capacity, distribution of the VAMP-windows on the Local Area Network...

CONCLUSION

For high integrity casting, where high quality casting with low porosity as well as repeatability in the process and evidence of the optimal fabrication are required, a high-speed secure vacuum valve is the only solution.

For advanced evacuation in high quality die-casting, the use of the Vacuum Analysing and Monitoring Processor (VAMP) can be a major advantage. This computer-assisted system with its embedded sensors, used in conjunction with a complete database built up from laboratory-measured vacuum curves, offers totally new perspectives for improving the pressure die-casting process, and not just for monitoring die evacuation.