DATASHEET A104-ST99 - (HVOF) VERBESSERUNG DER FLIESSGESCHWINDIGKEITSSTABILITÄT DES KERAMIKSCHLICKERS

APPLICATION NOTE A104-ST99

Improve ceramic slurry flow rate stability for thermal spraying process (HVOF)

In the high velocity oxy-fuel (HVOF) thermal spraying process, ceramic powders are injected into a flame to impact with a target substrate. As a consequence, the substrate surface is coated with a material that will allow a higher surface hardness with better abrasion resistance, or a better chemical resistance.



Whereas some HVOF processes employ the direct injection of dry powders into the flame, a process at the Faculty of Engineering of the University of Nottingham uses a liquid such as water to carry the powder into the flame, allowing to handle smaller particles down to the nanometric range. R&D of this university faculty occurs, for example, in the field of in-power generation, where application of these protective HVOF coatings allows combustion processes to occur at higher temperatures and pressures, thereby increasing the combustion efficiency and reducing the CO_2 footprint.

To improve the way in which the powder/liquid slurry is transported from the slurry-containing vessel to the flame, the university requested the help of Bronkhorst UK.

"Using the Bronkhorst ES-FLOW has fundamentally changed the way we do research" according to Dr. Tanvir Hussain from the University of Nottingham.

Application requirements

In the original setup, the pressure inside the slurry vessel was manually set by an operator, in order to supply the required flow rate of slurry into the flame. Measurement values of the used flow meter were not repeatable, and this needs to be improved. Moreover, the slurry flow rate would change easily due to changes in the slurry level, the supply pressure of the vessel and the pressure downstream of the vessel, so also the pressure control needs improvement. Furthermore, the original process very much relied upon the operator to notice these phenomena using the display on the flow meter, who then manually had to adjust the pressure as needed to try to establish the target flow rate again. All this resulted in a slurry flow rate stability with a value of ±10% or more, which needs to be improved.

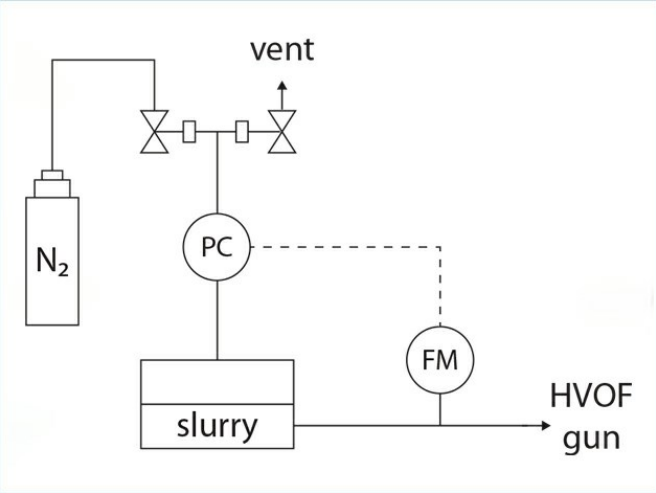
Important topics

- Flow rate stability
- Improvement of automation

Process solution

The Bronkhorst solution consists of a few consecutive steps, starting with the purchase by the University of an ES-FLOW ultrasonic volume flow meter to improve their flow measurement ability. Indeed, the flow rate can be measured more repeatable. In addition to that, due to the straight-through sensor of this robust liquid flow meter, abrasion of the ceramic particles in the slurry is virtually not an issue. The slurry is about 20% powder in liquid, and in the old as well as the new setup, the vessel is stirred to keep the slurry homogenous.

As an extension to the solution, a Bronkhorst EL-PRESS P-800 pressure controller is used in master-slave control with the ES-FLOW liquid flow meter. This configuration controls the pressure on top of the slurry vessel, to indirectly control the flow rate of the slurry being introduced to the flame. During the coating application, the operator is asking for a specific flow from the liquid flow meter, and this is being fed back to the P-800 pressure controller - which is, in effect, a pressure meter with two control valves. So the liquid flow meter is controlling the control valves, to indirectly control the flow rate by changing the pressure. For the current application, 40 ml/min of slurry is a typical flow rate. The pressure in the vessel is controlled in the range from 0 to 5 bar gauge, with a typical value of around 4-4.5 bar.



Flow scheme

However, the first test results with this setup are actually too good. The control is too stable: a slurry flow rate stability of ±0.2% is obtained. At the downside of this, the response time to achieve control is too long. It takes over one minute to reach stability, and that is a waste of expensive slurry. To solve this issue, the size of the control orifices of the pressure controller is changed from 0.2 mm to 0.5 mm. Now the control is better than ±1%, with a sufficiently fast response time.

The operators are very satisfied with this solution. They do not have to constantly watch and manually adjust the flow rate, and the stability of the slurry flow delivery is far better than they ever achieved manually, and with very little wasted slurry. Moreover, they now have data acquisition and computer control of this part of the process.

This solution has not happened because of 'just one Bronkhorst product', but due to a long-term relationship with the client, which evolved and developed over 2-3 years - giving them what they need using Bronkhorst products.

Recommended Products



ES-FLOW™ ES-103I

Bereich 2 ... 1500 ml/min

Druckstufe 10 bar

IP66/IP67 Display; Touchscreen

Hygienisch, Flanschtyp-Design



EL-PRESS P-802CV

Min. Druck 17,5...350 mbar
Max. Druck 3,2...64 bar

Absolut- oder Überdruck

Schnelle Druckregelung

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