# Reduction of the amount of purge gas during temperature measurement in stove domes by 80%

**by Albert Book**


**Fig. 1** *Pyrometers measure the temperature of the grating refactory bricks in the stove dome from the cupola*

A large amount of nitrogen is used to keep the optics and the field of view clean during optical temperature measurement in a stove dome. A simple yet ingenious measure allows the amount of gas to be reduced by more than 80 % at no great cost, while at the same time improving operational safety.

## Temperature measurement in a stove dome

In a stove dome, air is heated to approx. 1300 °C before feeding into the blast furnace. For this purpose, cold fresh air flows from bottom to top through preheated grating refactory bricks. The temperature of the grating refactory bricks is measured optically using pyrometers. These are mounted on the cupola of the hot-blast stove and detect the infrared radiation of the refactory bricks from a distance of several meters through a sighting tube (**Fig. 1**). The pyrometer determines the temperature from the infrared radiation according to Planck's law. For safety reasons, two redundant devices are often used, which are installed in parallel in a protective and a mounting fitting (**Fig. 2**).

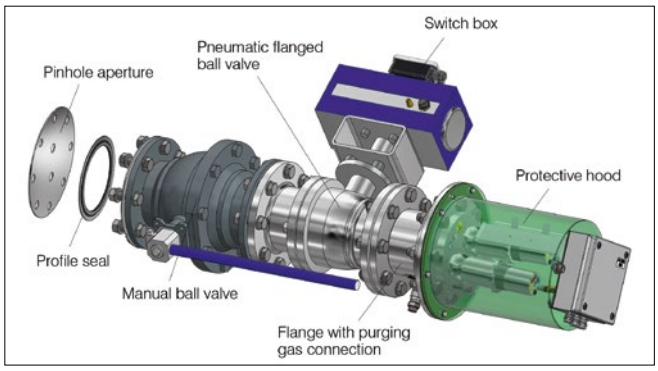


**Fig. 2** *Mounting fitting consisting of protective hood, flange with pressure-resistant window and purge gas nozzle, pneumatic valves, manual valve and pinhole aperture*

## High requirements on the measuring system

Due to extreme metrological conditions, high requirements are placed on the measuring system. The devices are exposed to external weather conditions. Depending on the country and geographic region, the ambient temperature can be between -40 °C and +80 °C. To protect the pyrometers from extreme cold, a heater with thermostat is installed in the protective cover of the pyrometer and in the switch box. At very high outside temperatures, gas is flushed through the cover for cooling. If the temperature of the electronic devices exceeds or falls below the permissible operating temperature in the event of a fault, the control system of the system releases an alarm. The internal temperature of the pyrometer is permanently monitored.

High dust concentrations can occur in the stove dome. Therefore modern pyrometers are used, which work according to the two-colour measurement method. These react to such disturbing influences as far as possible insensitively. A weakening of the infrared radiation by dust or smoke in the field of view or a contamination of the viewing window leads directly to a reduced temperature indication with a conventional single colour pyrometer. A two-colour pyrometer delivers reliable measured values even with a signal weakening of 90 %.

In order to keep the protective glass and the sight tube free of impurities, nitrogen is blown into the mounting fitting through a nozzle. Due to the two operating states of the stove dome during the heating of the storage stones and during the generation of hot air, the pressure in the stove dome varies between normal pressure and an overpressure of up to 5 bar. The construction requires an inner diameter of 150 mm for the mounting fitting when mounting the two devices installed in parallel. The nitrogen consumption is correspondingly high in order to generate the necessary counter-pressure. Thanks to an actually simple yet ingenious invention, KELLER ITS has succeeded in reducing the amount of gas by at least 80 %. For this purpose, a pinhole aperture with two openings is installed between the mounting flange of the stove dome and the mechanical valve (**Fig. 3**). The reduction of the free opening also significantly improves the cleaning effect. In the event of a leak in the mounting valve, the perforated screen also allows considerably less dangerous hot gas to escape from the stove dome in the event of a malfunction.

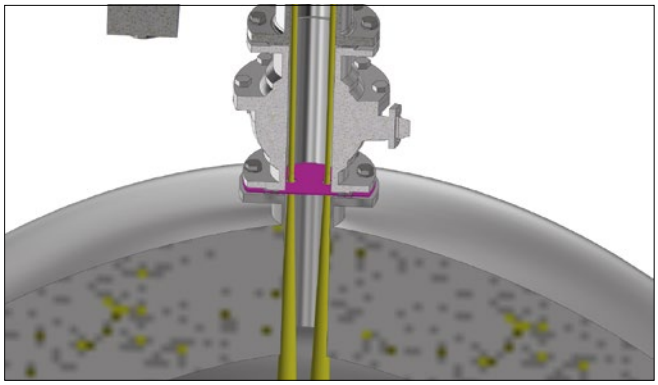

**Fig. 3** *Pinhole aperture with two openings*

## Metrological solution

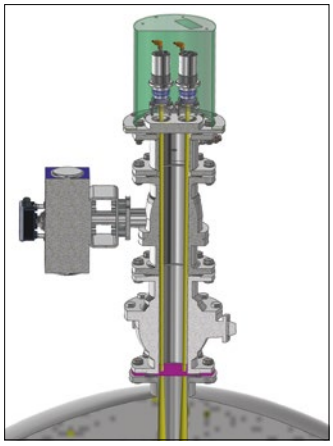

**Fig. 4** *Precision pyrometer with high-quality optics and narrow field-of-view*

Prerequisite for the use of the pinhole aperture are high-quality optical pyrometers with a narrow optical field-of-view to measure unhindered through the opening (**Fig. 4**). The focus point of the instruments is adjusted to the distance to the pinhole aperture. The exact alignment is achieved by a ball joint. For this purpose, an opening is provided in the mounting fitting, through which the perforated screen is illuminated via an external light source during commissioning. The devices are equipped with a through-the-lens sight to check the focusing and alignment.

A flange with one viewing window per pyrometer is installed for pressure-tight sealing. A pneumatic valve closes the opening to the stove dome in the event of a pressure loss in the

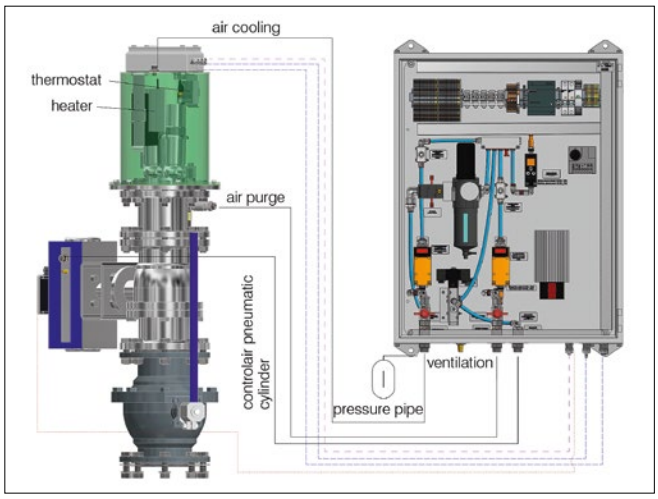


**Fig. 5** *Purge cabinet with electrical and pneumatical control elements*

purge gas, a power failure or an impermissibly high ambient temperature. This is to prevent the measuring system from being damaged by escaping hot air at temperatures up to 1300 °C. In addition, a non-return valve on the purge gas nozzle closes if hot gas should escape there in the event of a defect in the air hose. A mechanical shut-off valve is provided for maintenance purposes.

A further measure was taken to additionally increase the operational reliability of the measuring system. Modern two-colour pyrometers have a function for monitoring the signal intensity. This signal is used to monitor contamination of the protective window or clogging of the sighting tube. At the same time, it can be used as an indicator of the operating status in the stove dome. The signal intensity is transmitted via the second analogue output or the digital interface of the pyrometer to the control system of the plant where it is recorded and evaluated. The purge cabinet contains the nitrogen supply unit for purging, cooling and for controlling the pneumatic valve (**Fig. 5**).

## Conclusion

Sometimes it is not complex but simple inventions that lead to enormous improvements. And afterwards you ask yourself why you didn't think of it before. By using a pinhole aperture in combination with optically suitable pyrometers, the consumption of purge gas for a measuring system to record the internal temperature of a stove dome can be reduced by more than 80 % without incurring any significant costs.

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