Fig 6.

Within the LVJB is placed a signal processing unit. This gives signal to a control unit, the main function of which is to control and monitor the switch used for pulse generation. This switch is equipped with two IGBTs, also placed in the LVJB. The LVJB control unit communicates with the PC control unit placed in the control cabinet by means of a can bus.

A control cabinet contains the PC control unit, fuses, main contactor, thyristor controller for the base high voltage supply, thyristor controller for the pulse power supply, thyristor firing unit and the PIACS-Coromax automatic control unit. The latter communicates with the DC control unit and monitors the pulse system (corona current, sparks during pulse, sparks between pulses) and automatically controls base voltage, pulse voltage and pulse repetition frequency, in accordance with a programmed control strategy, aimed at maintaining maximum precipitator efficiency with the resistivity level present in the precipitator.

> Without doubt, the Coromax pulse system represents the most economic upgrade solution for existing electrostatic precipitators.

Power consumption

A special advantage of the Coromax pulse system is its low power consumption when operating with difficult dust. In a normal DC power supply, current flow cannot be controlled independent of the high voltage. With a high level of voltage, the current flow will also be high. The current creates back corona at high resistivity dust and will increase dust emission. This high current is wasted in the collection process, giving high power consumption and no benefits (Fig 6).

With increasing resistivity, it is essential that the current is reduced to avoid back corona. This gives two effects, one being that dust emission is reduced (no back corona) and the second that power consumption is decreased (lower current). When using the FLSmidth Airtech Coromax pulse system, all current is used for the collection of dust and none is wasted (Fig 7).

Fig 7.

Advantages

With the Coromax pulse system, it is possible to overcome problems encountered with small particle sizes and high resistivity of sinter strand dust. In the equipment's design, base voltage, pulse voltage level and current flow are completely independent. Therefore, precise adjustments to resistivity levels can be achieved. The emission reduction factor is equivalent to a 50% increase in collection area compared to a DC power supply ESP.

Without doubt, the Coromax pulse system represents the most economic upgrade solution for existing electrostatic precipitators.

Reader Reply No. 40

Aluminium electrode arms maximise operating efficiency

In June 2009, BSE introduced a range of current conducting electrode arms made from aluminium, following the BSE tradition of applying continuous improvement to its products. Klaus Kimmer and Martin Selzer* describe the technology's history, features and operational experience.

Current conducting arms featuring copper-plated surfaces were developed at the beginning of the 1980s. The first unit was started up in 1984 in an electric arc furnace with a transformer capacity of 36MVA.

The original design was characterised by a low loss and low reactance operation, resulting in an optimised, effective power input. Furthermore, significant maintenance-related advantages were identified, as there were no maintenance-intensive insulation parts between the supporting structure and the current conducting busbars. Since that time, most conventional arms have gradually been replaced by current conducting designs.

A further development was the current conducting electrode arm made from aluminium, with removable electrode holders, identical for all three phases. This type of electrode arm came into operation for the first time in 1989 at Badische Stahlwerke in Kehl, Germany, where it has proved to be highly reliable and successful for a plant with high productivity objectives.

Aluminium arms in operation.

Design features

The BSE aluminium electrode arm design needed to take into account a number of severe conditions and operational requirements:

- Operation in the rough environment, on electric arc furnaces in steel plants;
- High availability;
- Easy handling in combination with a minimum of maintenance requirements;
- No special requirements regarding the quality of cooling water;
- Minimum losses at optimum reactance values.

The latest improved design meets these requirements. The aluminium alloy features good physical properties with regard to mechanical strength, it provides high corrosion resistance to cooling water and shows excellent electrical conductivity.

Unlike copper-plated arms, where only the outer copper layer is supposed to conduct the electrical current, only one material is used when the arms are made of aluminium. Consequently, current is conducted through a much larger and homogeneous cross-section. In addition, the density of nominal current is less and consequently, the losses resulting from ohmic resistance are lower in an aluminium arm.

A special feature of the BSE aluminium electrode arm is the flange-type design of the electrode holder. Each electrode arm consists of a supporting arm, which is insulated against the mast stool and fixed to it. The flexible power cables for connection with the transformer are attached to the rear end of the arm. The front portion of the electrode holder part of the design is attached to the arm by a flange connection, located at the front section of the supporting arm. All sensitive parts required for a mechanically secure yet electrically high conducting clamping of the electrode – to ensure high current transfer into the electrode – are placed in that flanged electrode holder. For AC application, all three of these electrode holders are identical and easily interchangeable, which keeps spare part stocks down.

The complete electrode arm is water-cooled. Cooling water is transferred from the supporting arm into the electrode holder through the main flange connection. The total volume of cooling water required passes through the electrode holder, ensuring optimal and efficient cooling of these sensitive parts.

Another fundamental difference compared to copper-plated and in particular, to conventional arms with current conducting copper busbars, is the considerably lower weight of the units, up to 60%–70% of other designs/materials. This results in a lower accelerating force to be generated by the control system and hydraulics, less load on the guide rollers at the lifting masts and consequently, reduced load and stress on the complete gantry during operation. It also results in an improved overall dynamic behaviour of the entire system.

Maintenance at BSW

At Badische Stahlwerke (BSW) in Kehl, Germany, scheduled production downtime for maintenance alternates between 10 and four hours weekly. During this time, electrode arms are checked visually. Where damage is identified, the complete electrode holder is replaced, necessitating cooling water to be drained, the electrode spray cooling ring to be taken off and the four fixation bolts between electrode holder and arm to be opened in order to dismantle the electrode holder from the supporting arm.

At BSW, replacement times for electrode holders takes less than two hours. The damaged electrode holder can be thoroughly checked in a specialised workshop under appropriate conditions, without disturbing the production process. A defective electrode holder can be completely dismantled, with all parts examined and cleaned. Damaged parts can be easily repaired or replaced.

As soon as the electrode holder is reassembled and has passed final inspection, including clamping force adjustment, the holder is considered ready and available for another operation campaign. In many cases, an electrode holder is continuously in use for more than 20,000 heats, which corresponds to an operation time of 18 months. The average operating time of an electrode holder is about 15,000 heats.

BSW has six electrode holders (the flanged front part only) for each furnace, three of which are in operation. Of the remaining three spare electrode holders, at least one must always be ready for use in a standby position. This arrangement guarantees that in case of damage caused by sudden arcing due to an electrode breakage, the respective electrode holder can immediately be replaced at an absolute minimum of downtime.

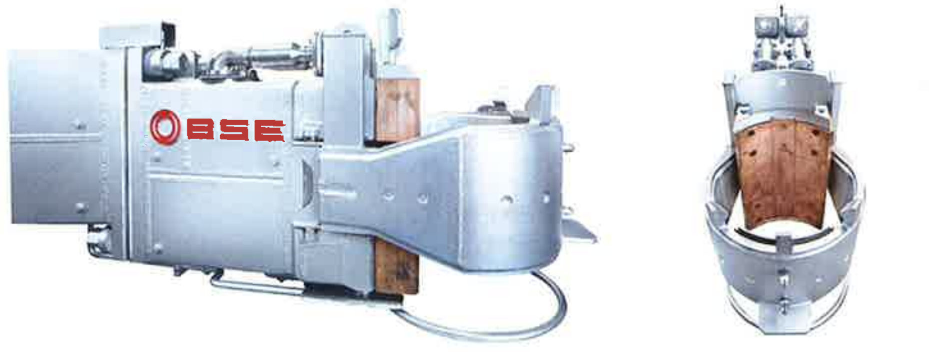
Operating results

The aluminium electrode arms at Badische Stahlwerke have been in use for 20 years, during which time more than 32 million tons of steel have been produced with two electric arc furnaces. In the past 20 years, the tapping weight of both furnaces has been increased continuously to 100 tons of liquid steel per heat.

Both furnaces are each equipped with a 90MVA transformer, supplying a maximum secondary voltage of 1041V. With the overall arrangement in place, an average active power input of 72MW is achieved.

The annual average tap-to-tap time in 2008 amounted to approximately 39 minutes, with delays of less than three minutes per heat. The fraction of delay times related to the electrode arms was insignificant.

Reader Reply No. 41



Side and front views of electrode holder.

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