Improving powder resistivity measurement accuracy

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Abstract

Powder resistivity is a substance safety parameter that permits to define how fast the electric charges generated during a process step will dissipate. This parameter is required to complete a standard ignition source analysis in order to assess the relevance of spark discharges, brush discharges and cone discharges. In addition, when the safety of a unit operation is based on charge dissipation, the powder resistivity has to be measured to assess the relaxation time of the substance and thus the required waiting time until charges are sufficiently low to complete the operation. The charge relaxation time is the product of the void permittivity, the relative permittivity of the substance and its resistivity. Among these, the relative permittivity ranges from 1 to 10 while the resistivity is expressed in powers of ten. The accuracy of the measurement of the resistivity is thus of first interest as in case of underestimation, the defined safety measures will not be efficient and in case of over estimation, the impact on the production time may be significant in particular for very resistive powders.

The determination of powder resistivity is based on the Ohm law. A defined voltage is applied between two electrodes and the overall resistance of the sample is estimated based on the measured current across it. The resistivity can be deduced from the resistance measurement based on geometrical considerations. As the maximal applied voltage is 1000V, the order of magnitude of the measured current is 10^{-9} A for resistances higher than 10^{12} Ohm. This value is small and reducing the measured resistance value would help to increase its accuracy.

The measured resistance is a function of the resistivity, the sample thickness and the contact surface between the powder and the electrode. Currently the official standard to be used to determine the powder resistivity is the IEC 80079-20-2:2016. The design of the electrode offers a contact surface between the electrode and the powder of 10 cm^2. Resistivities are sometimes also measured according to IEC 62631-3-1:2016 where the contact surface is two times larger than the previous electrode. However, even with this increase, the accuracy of the measurement could be improved. Hence a new and larger electrode with a contact surface of 200 cm^2

was designed and built. This article presents the advantages and the limits of this electrode based on a comparative study.