Application Note

Correct Calcium Carbonate Structure

with In-line Conductivity Measurements

Background

Calcium carbonate (limestone) is a widely abundant natural mineral with a diverse range of uses from additives for paints, plastics, cements and papers, to an ingredient in foodstuffs and pharmaceuticals. In many applications the particle size and molecular structure of the carbonate is critical for its use. In order to fulfill these requirements, precipitated calcium carbonate (PCC) is produced with specific physical characteristics in both particle size as well as molecular arrangement.

Process

The raw material for PCC is mined limestone, which naturally has a wide range of particle sizes and configurations as well as significant bulk and trace contaminants. The first step in PCC production is the processing of the limestone to calcium hydroxide. Powdered limestone is calcined at 1000 °C, which breaks down the carbonate to lime (CaO) and carbon dioxide (CO_2). The CO_2 is collected for reuse downstream. Adding water to the lime produces a calcium hydroxide solution. This solution goes through a purification step where unwanted species are removed.

Finally, the calcium hydroxide is reintroduced to the collected CO_2 which results in precipitation of pure calcium carbonate (now referred to as PCC) with particle size and molecular configuration that are dependent on the process conditions.

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Application Note

Different PCC particle shapes result in different bulk densities and surface areas. In comparison to ground calcium carbonate (GCC), PCC has smaller particles sizes as well as a narrower size distribution. Smaller particles are ideal for impact resistance in plastic, and a narrow distribution is desired in oil absorption applications.

Conductivities

Possible PCC structures include prismatic and scalenohedral forms as well as cubic or cuboidal arrangement. In the past, cubic and cuboidal types were the only forms possible. Later, it was discovered that crystal seeding could produce scalenohedral and prismatic types. It has since been found that different types can be produced through controlling conductivity and without the need for crystal seeding. Within the range of 100–1200 µS/cm, scaleonohedral structure will be produced, and between 1200–6000 µS/cm prismatic or colloidal structures will be favored.

The conductivity is defined by the species that have the ability to transfer electrical charge, namely calcium and hydroxide ions. Another influencing factor is the hardness of the water used (conducting species such as Ca^{2+} and Mg^{2+}), so acceptable ranges are dependent on the process conditions at any time. Measuring the conductivity is thus vital to ensuring that the solution has the proper characteristics for the desired products. Using an in-line conductivity measurement system becomes of increased importance, as conductivity can vary widely and change quickly, so real-time measurement is essential.

METTLER TOLEDO solution

Conductivity measurement in such slurries requires a rugged sensor design. The InPro® 7250 HT is ideal. Its inductive measurement method means that no electrodes are in contact with the process, and all measurement elements are protected by a sealed PEEK covering. This durable material exhibits strong mechanical characteristics, ideal for use in slurries with significant abrasive solids contact, is inert to harsh chemicals, and is extremely resistant to fouling.

InPro 7250 HT conductivity sensor

- Inductive technology with wide measurement range
- Chemically resistant PEEK body
- Fit-and-forget installation

M400 Ind Cond transmitter

- 2-wire loop powered transmitter
- Integrated signal diagnostics
- cFMus/ATEX/NEPSI Ex-approved for hazardous areas

With simple installation through a flange plate, the InPro 7250 HT is a fit-and-forget sensor. Easy commissioning with minimal maintenance means it will measure reliably for many months without requiring any servicing. The probe also includes a Pt 1000 temperature sensor built into the robust PEEK body for temperature compensation. A METTLER TOLEDO M400 transmitter is highly suited to the process and for outputting the measurement signal to a DCS system.

For more information, visit:

www.mt.com/InPro7250

www.mt.com/M400

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