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How are wastes entirely avoided in solid-state productions?

The top "waste management" requires entire avoidance of wastes in chemical manufacture. Thus, processes must run to completion giving pure products not requiring solvents for removal of excess reagents, unwanted side products, or catalysts by solvents for chromatography. Solid-solid and gas-solid syntheses (since 1984) are the techniques of choice, which upon proper milling can be scaled. For example, horizontal Simoloyer® ball-mills from 1 to 900 liters size are suitable and contain all technical requirements for waste-free industrial production. Lab-scale syntheses are preferably tested in double-walled ball-mills with temperature control at the 100–200 mg scale. Since the solids shall not melt during milling the suitable temperature below the eutectic one can be found by cooling or (if necessary) by heating (−78 to +120°C). Cooling and avoiding catalysts profits from activation energy decrease in solid-state reactions (including frozen liquids). This advantage is lost upon melting above the eutectic temperature leaving reactions incomplete and unspecific. Virtually all reaction types (also multi-cascade ones) across chemistry with reactive molecular solids, salts, ductile metals, and gases have been waste-free realized, and numerous scaled to 200 g batches, and some of industrial interest scaled to auto-batches (e.g. manufacture of Al + CNT) or continuous technical manufacture. The temperature control and the product-collection is essential and will be discussed in detail. Transfer of milling impact energy to the reacting system is only necessary for direct mechanical breakage of sigma bonds. The Simoloyer® ball-mills are also suitable for true mechanochemistry and for comminution when recycling by leaching.

Biography

Gerd Kaupp has completed his PhD from Würzburg University and Post-doctoral studies from Iowa State, Lausanne, and Freiburg University. He held a full-professorship till 2005 in Oldenburg, Germany, and he privately continues his research on wasteless solid-state chemistry (since 1984), AFM on rough surfaces (since 1988), the non-stochastic but versatile and better resolving sub-diffraction-limit microscopy for unstained non-fluorescing materials of all types (resolution <10 nm, since 1995), and (nano) indentations (since 2000). He has published more than 300 papers in renowned journals and has been serving as an Editorial Board Member of several scientific journals.

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