

Nanoparticulate formulations for concrete applications

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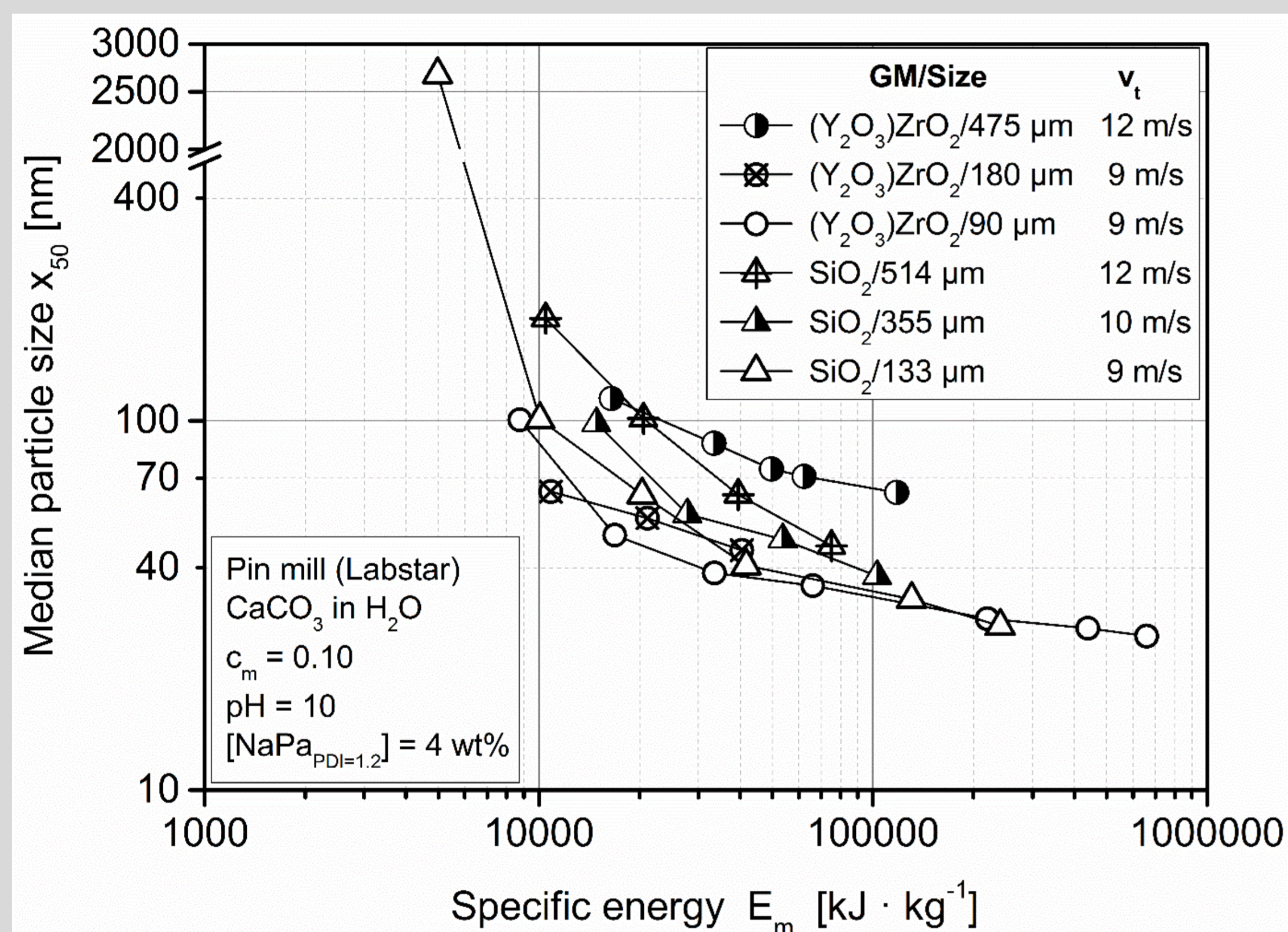
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Production of nanoparticles by grinding

Submicron and nanoparticles have aroused a wide interest and have gained new applications due to their high surface area and strength.

Nanoparticles can be produced by a wet chemical precipitation technique or by ultrafine grinding with stirred media mills¹. By producing nanoparticles with grinding, it is possible to achieve many properties that are not possible to achieve by precipitation. Probably the most important advantage is the production of nanoparticles from waste materials, like fly ash.

With stirred media mill, it is possible to grind particles down to their true grinding limit, as found for instance for CaCO₃².



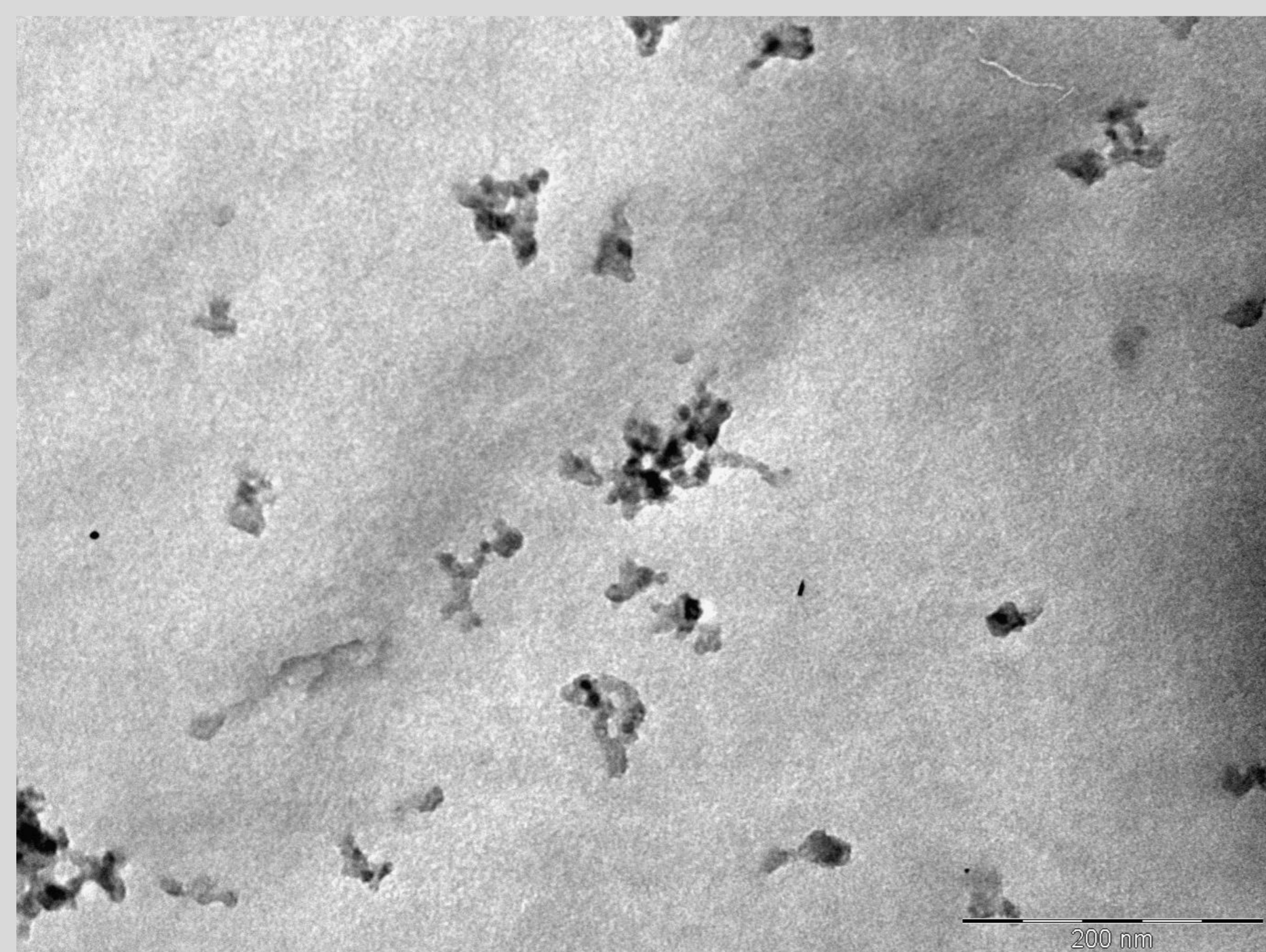
Particle size of CaCO₃ particles as a function of specific energy during stirred media milling.²

Nanoparticle production by ultrafine grinding



Tailored particle properties, particle mixtures,...

Nanoparticles from waste materials

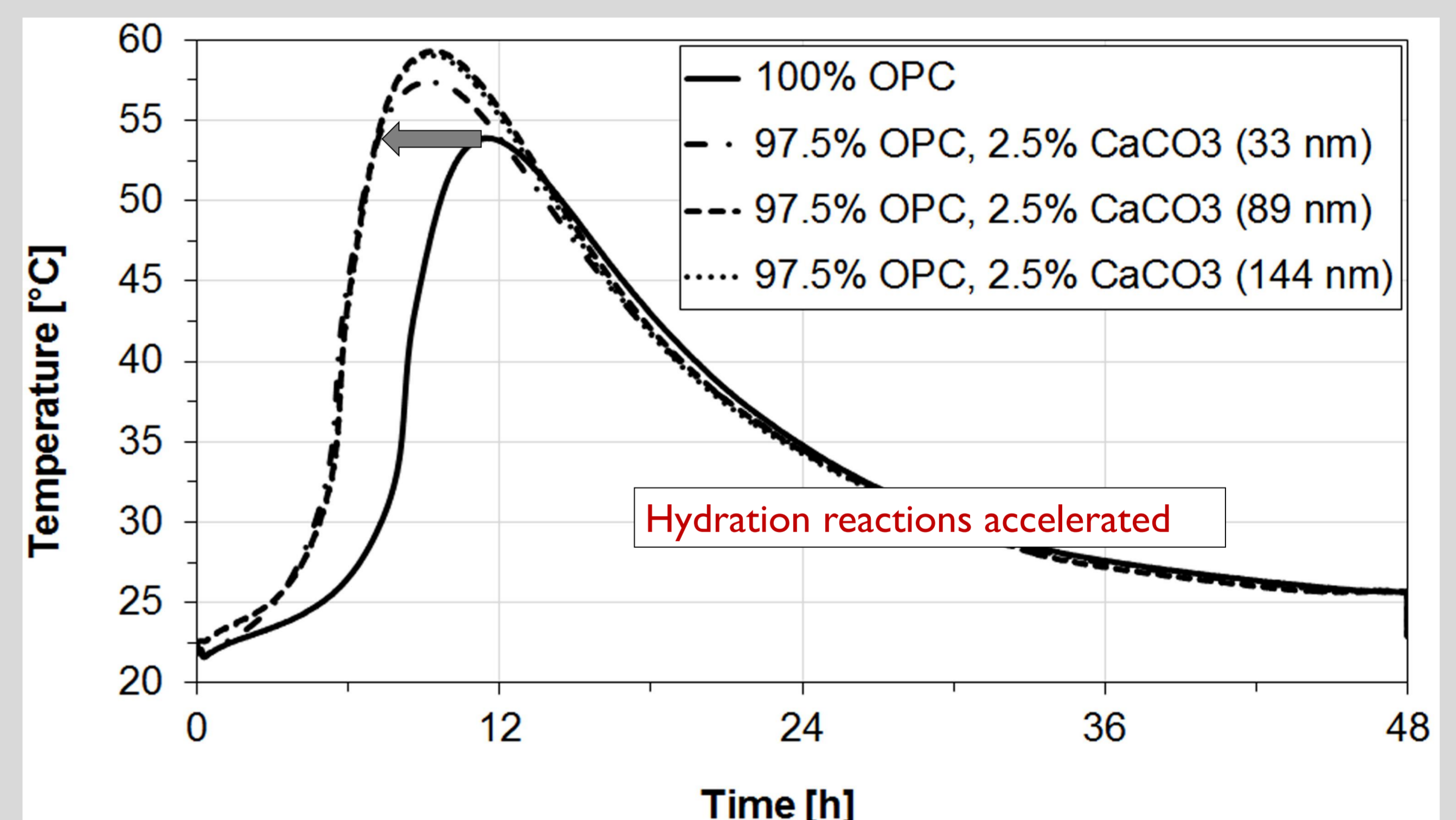


TEM picture of nano-CaCO₃ particles.

Nanoparticles in concrete

Addition of nanoparticles to cement has environmental and economic benefits:

1. Nanoparticles are able to accelerate early-age hydration reactions of the OPC³⁻¹⁰
2. Cement industry contributes by around 5% to the global anthropogenic CO₂ emission¹¹ and by reducing cement production by a partial replacement of supplementary cement material such as blast furnace slag and fly ash. These supplementary cement materials have a tendency to decelerate hydration reactions but by adding nanoparticles the hydration rate can be improved to be more like in a case of OPC¹²⁻¹³
3. Industrial waste materials can be used to concrete instead of landfilling



Heat of hydrations as measured by semi-adiabatic calorimetry.²

Inorganic nanoparticles and/or industrial waste materials to replace OPC



Improved concrete
Green concrete
New products

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