CONVERTING **RUSSIAN CLAYS** INTO NITROGEN FILTER AND NATURAL FERTILISER

Modern agriculture depends on the use of environmentally friendly fertiliser materials to ensure that healthy food can be produced with a high efficiency.

The small start-up company NanoGeo Finland Oy produces a natural fertiliser based on the common geological mineral vermiculite. The production of fertiliser is based on the utilization of nanoscale structures and properties of the mineral – when vermiculite is heated, its capability to absorb ammonium is increased. The absorption of ammonium results in the formation of ammoniumvermiculite, which is a fertiliser for plants. One source of ammonium for the fertiliser is ammonium-containing wastewater produced by human activity. This recovery of ammonium is a very useful technique that benefits agriculture as well as the environment.

MEASURING CRYSTALLINE PHASES

To understand the structural changes that take place during the initial heating of vermiculite, a study within the Science Link project allowed the analysis of several samples of NanoGeo's vermiculite, using intense x-ray radiation produced at the PETRA III synchrotron at DESY in Hamburg. X-ray diffraction (XRD) is used to measure crystalline phases present within a sample, and the beamline P02 is dedicated to high resolution powder diffraction at different

Figure NUMBER ONE

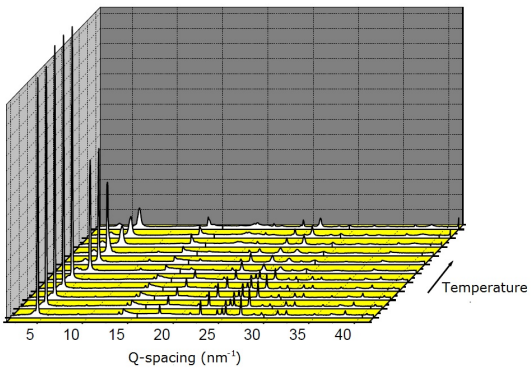

Figure 1 XRD data showing structural changes in Russian vermiculite during heating from 25°C – 580°C.

pressures and temperatures. The ability to create extreme conditions is complemented by time resolved diffraction capabilities in order to explore the kinetics of physical processes during a phase transition – a technique that is only possible at a synchrotron facility like DESY.

Powdered samples of the mineral were placed into glass capillaries and heated from 25 – 580°C. An XRD measurement was made every 2 – 3°C to observe the heat induced structural changes. The results are shown in Figure 1. It was found that during the heating, crude vermiculite passes through five discrete structural transformations, involving three steps of reversible dehydration and two irreversible dehydroxylation steps resulting in decomposition of the vermiculite to talc and, finally a form of $Mg_2Si_2O_6$.

REDUCING ENERGY CONSUMPTION

Results such as those shown in Figure 1, showed the temperatures of the structural changes of vermiculite required to create the best possible ammonium filter. This understanding has allowed NanoGeo to reduce the energy consumption of the manufacturing process of their filtering sands. Further measurements were performed on heated vermiculite before and after it was exposed to ammonia, and chemical reactions governing ammonia absorption by vermiculite were identified.

Science Link is a network between leading research facilities of photon and neutron sources and its users. The project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region. Apart from the research facilities, the network also includes scientific institutes, universities and regional organisations that serve as service and promoting units. Science Link is part-financed by the European Union (Baltic Sea Region Programme) and involves 17 partners from 8 countries during the project period 2012 to 2014.

For further information visit
science-link.eu

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Research facilities

DESY
HZB Helmholtz Zentrum Berlin
Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research
MAX IV LABORATORY