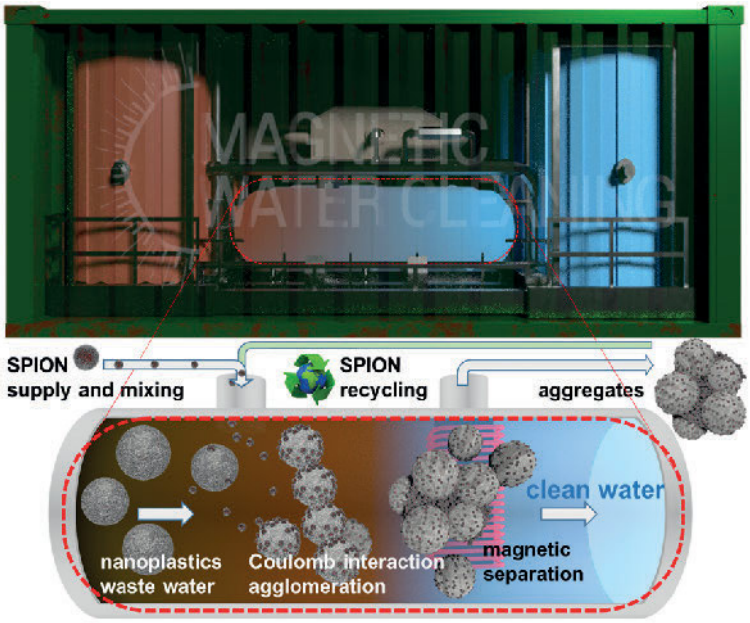

Fig. 4. Concept of a 20 feet container-based prototype.

for collecting further types of contaminants (e.g., toxic cations and hormones) is currently being explored with support from the German Research Foundation (DFG) and the German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt, DBU). However, putting our concepts into real-life application presents a completely different challenge.

From lab research to innovation

Currently, our team is pushing the scale-up in production of the core-shell SPIONs. Even if the remediation works efficiently and the materials can be recycled, the huge amount of pollutants calls for tonne-scale production of functionalised SPIONs.

A second task is to develop tech-scale remediation machinery – particularly adapted to nanoparticle collection. A first protype is envisaged as a full operating system unit (based on a 20-foot standard container, figure 4), including wastewater inlet, SPION dosage and mixing, magnetic separation, inline analytics (potentially recycling), and clean water outlet. This setup is scalable by parallelisation of several containers and usable for multipurpose cleaning based on different SPIONs. This endeavour is currently being pursued as a spin-off from academic research under the title MWC – Magnetic Water Cleaning. ■

1) *H. Park, A. May, L. Portillaet al.*, Nat. Sustain. *2020*, 3, *129–135*
2) *M. Sarcletti, D. Vivod, T. Luchs et al.*, Adv. Funct. Mater. *2019*, 29, *1805742*
3) *M. Sarcletti, H. Park, J. Wirth et al.*, Mater. Today *2021, doi: 10.1016/j.mattod.2021.02.020*

Window to Asia

Glycol lignin | A Japanese consortium led by Lignomateria Co. has inaugurated a demonstration plant in Ibaraki Prefecture for the production of glycol lignin. The technology, based on work at Japan's Forest Research Institute, uses polyethylene glycol (PEG) and dilute sulphuric acid at 140 °C to extract lignin from Japanese conifer trees. PEG preserves wood during processing. The annual production capacity is 100 tonnes and could be scaled up to several thousand tonnes. Prototypes of automobile hoods and biodegradable materials for 3D printers have been produced from glycol lignin. The annual consumption of plastics in Japan is about ten million tonnes; calculated from the growth rates of conifer forests in Japan, glycol lignin-based materials could possibly contribute more than two million tonnes.

Carbon market | China is attempting to build a nationwide carbon market. China's 4540 operating coal plants generate over 1,000 gigawatts, about half of the global coal power capacity, and generate 62 % of China's electricity, contributing over 40 % of the nation's energy-related CO_2 emissions. A team from China's coal industry and academia has investigated how carbon pricing will effect the financial sustainability and lifetime change of each plant. They conclude that even with a low initial carbon price of 50 CNY (6.6 €) von (0.4 euro) per tonne of CO_2 growing at 4 % per year and the permits being fully auctioned, the average residual lifetime of all the plants will be reduced by 5.4 years, and the CO_2 emission from 2020 to 2050 will be reduced by 22.7 billion tonnes.

Hydrogen as a fuel | According to the China Hydrogen Alliance, by the end of 2020 China had 7352 fuel cell vehicles and 101 hydrogen fuel stations in operation, ranking second in the world after Japan. By 2050, China's hydrogen demand is estimated to rise to about 60 million tonnes. Sinopec, one of the largest petroleum companies in China and the owner of some 30 000 petrol stations, has announced its intention to accelerate its energy business with hydrogen energy and transform itself into the world's leading clean energy company. To this end, the company plans to install 1000 hydrogen refuelling stations and 5000 charging and swapping stations by 2025.

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