

TVHT-reactor with Pebble Fuel Elements to Produce Hydrogen.

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Large scale production of hydrogen is one of the most important tasks for developing worldwide non-industrialized regions and has the potential for high economic impact. The condensation of sea- or wastewater is the best technology for desalination, but so far is very costly. Many chemical processes need high temperatures above 600 degree Celsius. One of them is the hydration of coal or CO₂ into car fuel

High temperature by nuclear energy is the most economical technology to lower the cost for these applications. When combined, the production of heat and electric power can minimize the cost for all secondary production processes.

This paper presents experiences and conclusions for the main design features of thorium very high temperature (TVHTR) power plants. These were gained from about 25 years of operations with the two German HTR-pebble bed reactors. The AVR experimental reactor (15 MWe/46 MWth) in Juelich and the THTR demonstration plant (300 MWe/750 MWth) in Hamm are the basic for the proposed design of future VHTR power plants.

The inherent safety-by-design of the pebble bed technology was demonstrated three times. In Juelich, Germany two tests of maximal credible accident (MCA) were successful in the 60ies and 70ies. In 2007 this was repeated at Tsinghua University, China, with the HTR-10, which is similar to the AVR. At these tests a total loss of coolant was initiated, all safety equipment was blocked, and no human intervention was allowed. No other nuclear power stations worldwide were even tried to stand a similar test.

This is why this technology is ideal to co-generate electricity and drinking water and/or Hydrogen – even in threshold countries and urban agglomerations. The HTR-PM in China (210 MWe) currently being built is a confirmation of this technology (which was unfortunately abandoned in Germany together with all other nuclear efforts). HTR power stations up to high capacities attain the best possible thermodynamic efficiency when high temperature is used for both: generation of electricity and subsequent processes. Cost for these processes are optimized with extracted pressures at various levels.

- When used for water desalination, the nuclear heat can be supplemented by solar energy to increase profitability.
- When used for hydrogen production, the well-established but expensive electrolytic process can be drastically lowered in cost.
- When used for car fuel production, the proven Fischer –Tropsch technology yields various synthetic fuels e.g. Ethanol, Methanol, Gasoline, Diesel, Kerosene, Hydrazine etc. One enormous advantage of these is the continued use of today's supply logistic.
- Other extractions from the temperature scale can be used for industrial gases, in the steel making process, remote heating of habitations, agricultural greenhouses etc.