EVALUATION AND DETAILED DESIGN OF A PILOT PLANT FOR THE CYCLE MARK 11

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SUMMARY:

Basic engineering study and cost estimate, on a pilot scale, of the thermochemical part of the MARK 11 - V7 cycle are presented. The design capacity is 10 Nm³/h H₂.

New operating conditions have recently been chosen for the H₂SO₄ thermal decomposition loop, which are rather different from previous ranges investigated: much larger dilution of active components by inert gases, increase of total pressure up to 40 bars. Consequently, we have a lack of data concerning following points: SO₃ - H₂O - H₂SO₄ equilibria, kinetics of the SO₃ catalytic decomposition and duration of the catalyst's life, experimentally checked correlations for the design of the H₂SO₄ vaporizer, corrosion tests carrying out all unfavourable process conditions (high pressure, turbulence,...). Additional research must be done on these different subjects. For design purposes, we had to make several assumptions which are presently not entirely reliable.

The main feature of the proposed flow-sheet is the H₂SO₄ adiabatic concentrating tower. This one is provided with air-lift systems assuring liquid recycles for a sufficient wetting of the packed sections.

The duration of construction materials is a critical point of this process. Thus, fiability problems and very high maintenance costs have to be taken into account in the calculation of the hydrogen production cost. By increasing the fiability, lower pressure working conditions may approach nearer the economic optimum, despite of the increase of the equipment size.