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MASS AND ENERGY BALANCES OF THE THERMOSELECT® DEMONSTRATION PLANT: PART III

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ABSTRACT

This is an original paper entitled, Part III: Material and Energy Balances of the Thermoselect Demonstration Plant in Italy. The planning and implementation of the demonstration plant was the result of theoretical studies that were independently proved and then combined into a facility that coupled the process steps: waste compression, drying and degassing, gasification with oxygen, and the subsequent direct melting of inorganic waste components. Special emphasis was placed on the equipment layout for the 'synthesis gas purification' and 'process water treatment' sections each of which is designed from calculations made during the preliminary phases of plant design.

The experiences gained from the industrial-scale demonstration plant (100+ t/d) have resulted in good agreement with the design parameters of operation and confirmed the correctness of the overall concept. Further developments relative to initial 1991 design concern in particular:

- Modification of the process step for the removal of the sulfur compounds as elemental sulfur from the synthesis gas. The recovery of elemental sulfur now being achieved by means of a regenerable iron-III complex, in solution rather than by oxidation of the hydrogen sulfide, followed by conversion of the resulting sulfur dioxide into calcium sulfate,
- The installation of a reverse osmosis unit to the process water recovery loop prior to the evaporator,
- The installation and normal operation of a 1 MW gas-motor generator module for the testing of the energy of synthesis gas in gas engines. In the commercial facility, the electrical requirements of an air separation plant (oxygen/nitrogen supply) and process heat requirements to dry the generated synthesis gas are covered by the thermal power coupling of the block thermal power plant that consists of several modules in a commercial plant. The engines also serve to discharge excess energy -- electrical energy and heat -- from the plant.

The experience gained in the demonstration plant has required only slight modification of the Thermoselect® process itself. On the other hand, the site-determined framework conditions have a significant influence upon the project-related material and energy balances, for example:

- The calorific value of waste and its cycle of availability,
- The component composition of the waste; water conent, organic component, inorganic fractions which in particular are also subject to seasonal variations,
- The pollutant fraction of the waste and pollutant compostion; heavy metals, chlorine content, etc.and the selected energy conversion method for synthesis gas utilization, synthesis gas utilization as an energy source using for example internal combustion engines, ignition-ray motors, steam turbines, gas turbines or the use of the clean synthesis gas for alternative fuels such as methanol, etc.

The results of studies at the demonstration plant provide the basis for the planned scale-up to the standard commercial plant (multiple 2 line process lines). The dimensional scale-up of the Fondotoce demonstration plant with the authorized capacity of a single thermal disposal line of 4.2 Mg/h (for Hu≤ 10 MJ/kg) to a series-plant thermal line with a 10 Mg/h capacity is surely possible with the aid of the knowledge gained from the practical operation of the Fondotoce plant. Planned on this basis of the