THERMOSELECT: ENERGY AND RAW MATERIAL RECOVERY THROUGH THERMAL CHEMICAL TRANSFORMATION IN A CLOSED-LOOP SYSTEM

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The authors have presented a unique *theory*. I firmly believe that the public wants a system such as the authors have described; the perfect system would take garbage in, and produce several streams of valuable byproducts while emitting little, if any, pollution streams.

The authors cite some prototype testing at Fondotoce, Italy. However, the paper gives the impression that perhaps *not* all of the suggested processing is a part of the present prototype operation. If this is the case, the reader should be clearly informed as to which of the suggested byproduct processing systems is presently operational at Fondotoce, and which are thought to be possible. Even though all of the suggested processing systems may be in use in other plants and other facilities, to have them all efficiently operating in coordination at one interconnected facility will be a sizable undertaking. For those that are operational, it would be good to include details of the actual prototype operation.

The authors state in their opening paragraphs that the continued addition of more efficient pollution control equipment "will be the only route open to allow (open combustion) systems to meet increasingly more stringent regulations." This is offered without defense. Are we to believe that the public is never to be satisfied at any level of environmental protection? Most professionals in this field of waste combustion agree that the most recent round of more stringent regulations will produce "environmental improvements" that are undetectable with any modern instrumentation at ground level. I say the authors have an excellent new idea to offer *without* taking shots at the existing systems.

While the system described in the paper is noteworthy for producing a smaller quantity of gas byproduct, there will still be heavy metals (i.e., lead, cadmium, mercury, etc.) contained therein, and the disposition of that heavy metal is too lightly dismissed early in the paper. It is later acknowledged to be a hazardous, or "special", handling problem (on page 174), again without sufficient detail for the audience to consider. In this same area of the paper, it is suggested that all of the water is recovered and reused in the system with none going to the sewer. How can that be with the high concentration of metal salts present in the process? Again, the reader needs more specifics about the processes.

Even though the volume of gases may be reduced by a factor of perhaps 5:1 by the use of oxygen in lieu of air, there will still be a substantial quantity requiring instantaneous processing unless some buffer storage for the gases is provided. Is this the case in Fondotoce? If not, how reliable is the gas processing system as a percentage of production time by the burner?

A most interesting paper. The authors should tell us more.

AUTHORS' REPLY

The comments offered by Mr. Norton are noteworthy and reflect the true purpose for technical forums: to challenge and to develop an appetite for more information. As with most initial papers which introduce a departure from generally accepted processes, there are never enough questions answered or adequate data presented. Our paper introduced a total plant concept for the treatment of a broad cross section of the solid waste stream combining well-researched chemical processes, thermal carbonization of organic substances, and gasification using high-temperature oxygen.

In an effort to bring the introduction of a concept forward to the current level of our developmental activity within the scope of this initial paper, we included actual certified performance test results. These test results were obtained not from laboratory bench scale experimentation or pilot plant batch operation, but from the continuous 24 hr/day operation of a 100+ t/d facility treating local curb-side commingled solid waste. This facility has now amassed over 8000 hr of operation, undergone start-up and close-down thermal cycling in excess of 30 times, and receives on-going engineering process improvements characteristic of all demonstration projects.

Additional information involving the products of the process is requested by Mr. Norton in his commentary. The products of the process include:[1]

• *Synthesis gas* (870 Nm^3/t) dry, clean, low-to-medium Btu content, usable as an energy source. In the demonstration plant, a portion of this gas is used for convection heating of the incoming compressed waste. This heating results in carbonization of the non-volatile organic portion of the waste input. Synthesis gas is also combusted in a 1.2 MW gas gen-set; any balance of generated synthesis gas in the demonstration plant is sent to a combustion chamber. A commercial plant of 528 st/d will generate ~10–12 MW; 4–6 MW are used for internal plant heat and electrical needs. The balance is available for outside energy uses; steam, electricity, alternative fuels, etc. Three sources of air emissions exist; channel heat combustion chamber flue-gas, exhaust from gen-sets, and emergency upset plant condition combustion chamber flue-gas. Emissions data for the process are beneath, in all categories, the stringent German 1_7BlmSchV emissions requirements for combustion sources and it is expected when the USEPA releases their final emis sion standards for Municipal Waste Combustion that this process will as well meet the new source performance standards.

• *Vitrified mineral product* (230 kg/t) that by European standards is judged inert and non-toxic, usable in cement, concrete, or as a road bed aggregate.

• *Metal pellets* (29 kg/t) in clean, ready for reuse form, derived from incinerator waste metal cans, other physically large metal sources such as white goods are shredded prior to being introduced to the process.

• *A concentrate of heavy metals* (7.5 kg/t) is isolated in-plant as a solid moist (40% solids) powder requiring special handling as a toxic substance.

• *Elemental sulfur* (2 kg/t) derived from liquid phase oxidation of the sulfur components contained in the gas stream.

• *A salt concentrate mixture* (12 kg/t) obtained primarily from the acid/base reaction of the water-soluble acidic gas components.

• *Distilled clean water* recovered from the gas cleaning and process water streams. The water is passed through a reverse osmosis step prior to reuse in the water loops and the hybrid heat exchanger sections.

RWTÜV of Essen, Germany, acting under the historical guidelines established by the Federal Republic of Germany between government, industry, and certified engineering testing laboratories, has assessed the design and the developing process for safety, critical operational processing parameters, construction material selection, and has also performed two (4000 hr/7500 hr) critical section tear-down examinations for wear, corrosion, and stress analysis. The data from these reports will provide subjects for future technical papers.

The authors will continue to report and publish in future papers the ongoing development of the process.

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[1]Waste input heat content: 10,000 M/j metric ton or 4265 Btu/lb. Waste input contains 50% organic,. 25% inorganic, 25% water.