PHOSPHORUS FIXATION IN TRIBUTYLPHOSPHATE/DODECANE/CALCIUM OXIDE SLURRY SPRAY FLAMES

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Discussion by

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I wish to make the following comments:
(1) During what stages are the materials (contaminants) easiest to remove? (i.e., oily, tar or taffy, brittle glass)
(2) Concern for scale up from laboratory to industrial size. Stay away from a quantum jump.
(3) What might a typical cost be for a plant to process 100-300 TPD (tons per day) of radioactive fluid?
(4) Could the resultant product (or by-product) be useful as a revenue generating item?
(5) How much of this fluid exists today? What would the plant size be to process these liquids? Have you thought about co-generation with solid waste?
(6) How does this process relate to existing technologies regarding radioactive fluids or liquid wastes? Is it practical or economically feasible in today’s marketplace?

Discussion by

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This is a good paper, which describes necessary research relative to control of pollutants. The concept is technically sound, and presumably can be developed to a state of practical usefulness. Such things as nozzle plugging referred to in the paper may give problems — which should be resolvable. The following are comments and questions:

ADVANTAGES

(1) The results indicate rapid reaction between lime and phosphoric acid, et. al.
(2) As expected, for reactions involving solid particles and gaseous to liquid compounds, an excess of the solid (CaO) is required and results indicate better interaction if stoichiometries exceed that required for the calcium-rich (orthophosphate) product.
(3) The concept appears to offer an effective means to sequester phosphorus in incinerator combustion products.

SUGGESTED IMPROVEMENTS

(1) Results indicate that phosphorus was removed at 60-90% efficiency. Statements implying “complete conversion” are thus not supported by the data. It is reasonable to expect further reaction beyond the filter, but presented data does not encompass parts of the system beyond the filter.
(2) It may be that products formed and deposited on filters will be a mixture of discrete calcium-phosphorus compounds, unreacted CaO and condensed or adsorbed acids. These will equilibrate and further react with time, with penetration of acid (or intermediate products) into CaO particles being the major rate-limiting factor. Treatment with water (i.e., the leach experiments) will hasten the equilibration process, and yield discrete compounds
dictated by Ca/P ratios. The authors appear to imply that this is the case, but tend to overemphasize the discrete compound formation point of view. Therefore, it may be possible that a 100% excess of CaO provides enough exposed (CaO) to trap most of the phosphorus, and that equilibration to discrete compounds is a slower process.

(3) Two results need an expanded explanation: (a) the high solubilities (relative to solubilities of Ca-P compounds) of Ca and P in No. 2 leachate, and (b) the failure to extract excess lime in No. 7. Might the No. 7 result indicate reaction of CaO with SiO₂?

In summary, the paper presents a potentially useful concept, investigated in a well-planned and executed research program. It is reasonable to expect “essentially complete” sequestering of phosphorus in incineration effluents, but results do not rigorously support such a conclusion. Finally, the authors suggest what may be an oversimplified picture of the removal process — which does not, however, detract from the potential attractiveness of the concept.