INCINERATING SEWAGE SLUDGE AND PRODUCING REUSABLE ASH: JAPANESE EXPERIENCE

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ABSTRACT
The paper titled “Incinerating Sewage Sludge Producing Reusable Ash: Japanese Experience” by Takeshi Okufuji, Takuma Co. Ltd. is reviewed. It recommends to consider and discuss additional factors in the evaluation of the incineration systems described and analyzed by the authors. Topics for discussion identified include drier capacity, ash physical/chemical properties, (elution test, ash behavior under varying weather/climate conditions), capital and operational cost data, an overview of system reliability/maintainability, permitting criteria, and a history of permit violation.

INTRODUCTION
The paper being discussed provides a statistical survey of municipal sewage sludge produced and incinerated based on Japanese Experience. The author investigates different concepts—adapted by the Japanese Industry for sewage sludge incineration—in terms of maximum heat utilization, disposal cost reduction, pollution control and ash reusability.

Evaluation is based on the analysis of two concepts: (a) dewatered sludge with 70–80% moisture content is dried to about 40–50% prior to being fed into the incinerator (drying/incineration system); (b) dewatered sludge cake with the same characteristics as above is directly fed into the incinerator (direct incineration system). In both concepts a step-grate type sludge incinerator is used with waste heat boiler to recover heat from the off-gasses leaving the incinerator. The dryer system is an indirect steam-tube dryer, utilizing steam produced by the waste heat boiler. The dryer is operated in closed circuit. Water is evaporated by circulating hot air with the water condensed in the dehumidifier. The dehumidified air is preheated indirectly in a heat exchanger, using steam, then recycled back to the dryer. Off gases from the waste heat boiler are processed for contaminant control, but there are no details given.

DISCUSSION
Incinerator systems for both concepts (drying/incineration, direct incineration) are well described. The bases and conditions used to calculate heat balances are well defined. Heat balance results tabulated and illustrated (Shankey diagrams) are correct. According to Okufuji, results favor the system equipped with dryer for the reasons presented as follows:
(a) Provides reduced heat loss.
(b) Attains more effective heat recovery in the waste heat boiler.
(c) Provides self-sustaining combustion, stable combustion without auxiliary burner.

(d) Produces semi molten ash with characteristics more suitable and adaptable for reuse.

The following comments are offered:

(a) The paper does not adequately determine the dryer capacity in terms of removing moisture content. Why is remaining moisture content selected at 40-50%? It appears from the paper that remaining moisture content is limited by the amount of steam produced by the waste heat boiler without use of auxiliary fuel. Would it be more beneficial to reduce the remaining moisture content of the sludge from the dryer to about 20%? This leads to another question. What is the temperature of the sludge in the dryer? In the presence of air, sludge will ignite at low temperatures if the moisture content is low. Is it most economical to split the drying process equally in two pieces of equipment (one is the steam-air-sludge dryer and the other one is the first section of the step-grate incinerator itself) or reduce the moisture in the dryer just to the point where the sludge will burn autogenously?

(b) Conclusions drawn by the author in his comparative analysis is based on heat balance results only. It would enhance the practical value of the paper if consideration was also made of the effect of the following factors:

1. Capital Cost
2. Operational Cost (including maintenance)
3. Financial Analysis
4. System Operational Reliability/Maintainability
5. Pollution Regulation Design Criteria, Permitting Condition/Criteria
6. Operational Data vs Permit Condition/Criteria

Heat balance comparison between two systems is insufficient in making a choice. Required is a financial analysis which includes capital costs, operation and maintenance costs, debt service, revenues where applicable, and disposal costs. For instance, the favored system includes extra equipment such as a steam-air heat exchanger, a hot air sludge dryer, and a dehumidifier cooled by water or ambient air. If the dehumidifier is cooled by water, is there a water cooling tower included?

(c) The paper provides useful information regarding the characteristics of ash and concepts describing potential areas for use. However, elution test data may be improved by providing information/discussion with regard to test conditions including kinetics and leach parameters, definition of mineralogy and distribution of the contaminants (heavy metals) in the ash.

Softening, melting data suggest that a partially molten ash may cause unacceptable problems on the grate. A discussion of the above and/or providing additional information would be helpful.

(d) Finding economical ways for using ash needs further research and experience, especially when use requires further process treatment for the ash. Effort should be made to define requirements for ash processing including determination of optimum particle size, specification of additive materials and determination of firing requirements. Use of ash for road and building construction by the aggregate industry requires a better understanding about ash weather/climate resistibility/leachability and its long term adverse effect on human health.

Because pollution is a major consideration, it would be important to indicate the levels of certain contaminants in the effluents. Included are NOx, SOx, organics, particulates, dioxins, vent gases, and liquids. Can the condensate from the dehumidifier be sent to the sewage?