EAS-ISWA '81

5. Europäisches Abwasser- und Abfallsymposium EAS
München, 22.—26. Juni 1981

5th European Sewage and Refuse Symposium EAS
Munich, 22 to 26 June 1981

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Symposium der Internationalen Vereinigung für Abfallbeseitigung und Städtereinigung — ISWA

Symposium of the International Solid Wastes and Public Cleansing Association — ISWA

Symposium de l'Association internationale pour les Résidus solides et le Nettoiement des Villes — ISWA

DOCUMENTATION

Das EAS ist ein gemeinsamer Kongress folgender Vereinigungen:

The EAS is a joint symposium of the following associations:

L'EAS est un symposium commun des associations suivantes:

A	Österreich/Austria/Autriche:	Österreichischer Wasserwirtschaftsverband
B	Belgien/Belgium/Belgique:	Comité Belge de l'I.A.W.P.R.
CH	Schweiz/Switzerland/Suisse:	Verband Schweizerischer Abwasserfachleute
D	Bundesrepublik Deutschland/ Federal Republic of Germany/ République Fédérale d'Allemagne:	Abwassertechnische Vereinigung e.V.
DK	Dänemark/Denmark/Danemark:	The Danish Water Pollution Control Committee
F	Frankreich/France:	Association Générale des Hygiénistes et Techniciens Municipaux
GB	Großbritannien/Great Britain/ Grande-Bretagne:	The Institute of Water Pollution Control
I	Italien/Italy/Italie:	Associazione Nazionale di Ingegneria Sanitaria
NL	Niederlande/Netherlands/ Pays-Bas:	Nederlandse Vereniging voor Afvalwaterbehandeling en Waterkwaliteitsbeheer N.V.A.
S	Schweden/Sweden/Suède:	Svenska Vatten och Avloppverksföreningen
SF	Finnland/Finland/Finlande:	Vesiyhdistys r.y. - Water Association Finland

Das ISWA-Symposium ist ein Kongress von 28 offiziellen Ländermitgliedern der ISWA

Symposium ISWA is a congress of 28 official national members of the ISWA

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5. EUROPÄISCHES ABWASSER- UND ABFALLSYMPOSIUM EAS

SYMPOSIUM DER INTERNATIONAL SOLID WASTES AND PUBLIC CLEANSING ASSOCIATION — ISWA

vom 22. bis 26. Juni 1981 in München

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Tagungsthema EAS-ISWA:

Allgemeine Probleme von EAS-ISWA: Anwendung der Abfallverbrennung zur Klärschlamm-Behandlung und -Beseitigung
Common problems EAS-ISWA: Use of refuse incineration for sewage sludge treatment or removal
Problèmes communs EAS-ISWA: Utilisation de l'incinération des ordures ménagères pour le traitement ou l'élimination des boues des stations d'épuration.

Diskussionsleiter
J. *Déféche*, France, P. *Fouquet*, France

5. Tagungsthema:

Phosphorelimination
Phosphorus removal
Elimination de phosphore

Diskussionsleiter
Dr. L. *Lijklema*, Netherlands

Symposium der International Solid Wastes and Public Cleansing Association — ISWA

(Gemeinsame Vorträge EAS/ISWA siehe Seiten 1—90)

SLUDGE INCINERATION IN DORDRECHT (NETHERLANDS)

Ir.L. van der Burg, Gevudo, Dordrecht

1. GENERAL

The sludge of the sewage plant in Dordrecht is dewatered, dried and incinerated. Dewatering is achieved by means of centrifuges. A multiple hearth incinerator is used for drying and incineration. Before going into the method of sludge treatment, I would like to discuss the way the choice was made on this treatment and to give a description of the combined plant for refuse, sewage and sludge treatment.
When the domestic refuse incineration plant of Dordrecht, built in 1938, after 25 years of service, started to show signs of wear, plans had to be made in the early sixties for the building of a new installation. Due to the absence of a sewage treatment plant in Dordrecht, all sewage water was directly discharged into the river. (Beneden Merwede). However this situation could not be maintained.
Therefore the idea was brought forward that a combined refuse and sludge treatment plant could be useful. Keeping in mind this idea the following criteria had to be met:

1. The refuse treatment had to be achieved by means of incineration and had to serve a community of 280.000 inhabitants.
2. The sewage treatment plant would only serve the municipality of Dordrecht (100.000 inhabitants); Industrial sewage was estimated to be equal to 40.000 inhabitants.
3. The combination refuse-sludge treatment had to be techically and economically viable.
4. It was virtually impossible to find or create a market for the digested dewatered sludge in the surrounding region of Dordrecht. One has to keep in mind that the disposal of this sludge had to be assured throughout the life of the installation.
5. The resulting flue gasses had to be treated and cleaned according to government regulation and therefore cooled.

The released heat should be used as efficiently as possible.

6. The necessary equipment for each stage of the process must have been sufficiently tested and be supplied by reliable companies.

An investigation into the combined composting of refuse and undigested sludge showed that this was technically possible, however this method presented problems in relation to the diminution and iron removal in the refuse. Also the removal of organic and inorganic components that cannot be composted. The largest drawback however, was that for the endproduct no stable market could be found. A closer investigation of the above mentioned consideration showed that thermal sludge conditioning was not preferred, because of the increased load on the water treatment plant. Of all the oxidation processes neither the pyrolysis method nor the fluidised bed method were commercially available at that time.
Due to this, only the multiple hearth incinerator, as used in the roasting of ores, could be considered.
Except, for the during incineration released flue gasses, only the inorganic substances of the sludge remain.
The furnace was already is use for the incineration of sludge, whereby it was necessary to dewater the sludge to a 15 to 20% dry solids and heat had to be added. The common incineration of domestic refuse and sludge practised in Ebingen and Bülach, demands in any case removal of iron and diminution of the refuse resulting in a high rate of mechanical wear, as well as in the mixers as in the furnaces. With an improperly controlled process or by using a low calorific value of the refuse, the temperature in the upper part of the incinerator will drop down too far.
In-complete incineration and pyrolysis will occur and thus cause odour problems. This has already occured at the Bülach installation, which had to be closed down due to the inconvenience the odours caused.

The combined incineration without prior diminution and mixing of refuse and sludge in grate type incinerators, as is common for refuse incineration, leads to the formation of balls of sludge which are carbonised on the outside but unburned on the inside. They give odour problem at disposal.
Spraying of sludge on refuse gives rise to objections on hygienic grounds. When on top of that it was shown that the incineration capacity had to be enlarged with the sludge contribution it was comcluded that the building of a special sludge incinerator next to the three planned refuse incinerators was the best solution.

2. RELATIONSHIP BETWEEN REFUSE INCINERATION SEWAGE TREATMENT AND SLUDGE INCINERATION PLANT

Attachment 1 shows the relationship between the different parts of the installation. In the refuse bunker is dumped:

- -domestic and industrial refuse
- -coarse refuse after diminution
- -sediments from the degritter of the sewage treatment plant
- -floating matter from the sewage treatment plant

After mixing this refuse is incinerated in the grating incinerators at a temperature of 800-1000° C. The experts may like to know that these furnaces are supplied by Martin Munich. After incineration the residue consists of slag, iron and flue gasses of 800-1000° C.
The sewage treatment plant consists of a degritter, primary sedimentation, aeration- and secondary sedimentation basin. In these basins are treated:

- -the waste water of the Isle of Dordrecht
- -the pre sedimentated, used washwater from the scrubbers and also the backwashwater from the drinking water treatment plant in Dordrecht.

From the sewage treatment is subsequently discharged:

- primary sludge from the primary sedimentation basin and surplus sludge from the secondary sedimentation basin, which are together taken to a thickener.
- the effluent is discharged into the river Beneden Merwede. A part of the effluent is however used as washwater in the flue gas-scrubber and as cooling water.

The thickened sludge from the thickener is further dewatered and centrifuged and subsequently discharged into the sludge incinerator. A part of the flue gasses from the refuse incinerators is led into the sludge incinerator countercurrent to the sludge, as a result of which drying and incineration of the sludge takes place. The ash from the sludge incinerator is discharged into containers together with the residue of the refuse incinerators by means of a conveyer belt. A magnetic belt ensures that slag and iron are deposited in separate containers. The iron is disposed off to the scrap iron trade and the slag is dumped.
Research has been done to find possibilities and application of the slag in pavement stones as substitution of gravel. The result is that some experimental pavement stones of good quality have been made, therefore the possibility exists that future slag can be used in road construction. In every pavement stone with a weight of 3 kg upto 1 kg of slag can be incorporated.
The flue gasses from the refuse incinerator, as well as the flue gasses used in the sludge incinerators are washed in the scrubbers. This scrubbing is done with sewage water.
Residues from the scrubber are:

- washed flue gasses, saturated with water vapor
- polluted washwater

3. **FLUE GASWASHING**

The raw flue gasses are containing flyash and also corrosive and harmfull gasses like SO_2, NO_x, HCl and HF.
With application of electrofilters only the solid particles would be removed and not the harmfull gasses. Before flue gasses can be passed through electrostatic precipitators it is necessary to cool them down to 250-300° C.
This cooling process can be achieved by means of the production of steam, cooling with air or evaporation of water in the gasstream. Steamproduction was rejected for economical reasons. The argument being that there was some fear that a growing proportion of halogenated plastics would cause excessive corrosion to the steampipes, which evidently would be a large source of unscheduled stoppages. It is important to realise that these ideas date back to the sixties, while then the energy conservation problems did not yet exist.
Lowering of the flue gas temperature by means of adding air makes it necessary that the induced draught fan and electrostatic precipitators have to be 3 times as big as normal. This in turn means larger investments and a higher energy consumption. By evaporation of water injected into the gasstream the temperature of the flue gasses can be lowered. By cooling the flue gasses to such a temperature that the water only partly evaporates, polar gas molecules can dissolve in the water phase, whereby not only the solid particles, but also the harmfull components are removed. The temperature of the washwater as well as the flue gasses must not exceed 70° C. after the washing process.
Due to the application of radial flow scrubbers electrostatic precipitators were not required. The required water is obtained from the effluent of the sewage treatment plant.
For a refuse furnace with a capacity of 7 Mg/h, for each scrubber about 90m^3 water/h is supplied of which 20 m^3/h is evaporated. The scrubbed and cooled flue gasses are saturated with water which causes a stack plume. By a tangential introduction of the scrubbed gasses, into the stack, not

evaporated water droplets will be caught and ejected. This due to centrifugal force. Not only flyash but also HF, HCl, and a lesser extent SO_2 will go into solution in the remaining washwater. Results of gas scrubbing are in average:

	raw flue gas	scrubbed	reduction	emission
HF	15 mg/m^3	6,0 mg/m^3	96 %	0,1 kg/h
HCl	600	70	88	8,4
SO_2	280	135	52	16,2
Flyash	1200	110	92	13,2

The effect of scrubbing on NO_x has not yet been determined. The pH of the washwater decreases from 7 to a pH less than 5. pH correction is achieved by adding $CaCO_3$ - containing rinsing water of the nearby water treatment plant. This correction is not normally necessary, but serves as protection for the concrete parts, which are attacked if the "acid" water has a too low pH-value before it is fully mixed with sewage water. A good protective coating on the concrete parts could also be a solution. The temperature of the sewage water will increase about 8 to 12° C. after mixing with the washwater (70° C.) depending on the quantities of supplied water. This temperature increase causes a larger bacterial activity which in turn creates an improved cleaning capability, especially in view of nitrogen reduction. Also volatile substances will be present in the flue gasses and subsequently be absorbed by the water. After the scrubbing process zinc, lead, copper, cadmium and chrome have been found in the washwater. They will partly settle in the washwater sedimentation basin and partly in the primary sedimentation basins.
So it is possible these heavy metals come in a vicious circle, or are ejected together with the ash of the sludge incinerator or into the air.
A quantitation analysis has to be made.

There are indications that the biological cleaning process is negativily influenced by heavy metals. An investigation has to be made. A large variety of heavy metal compounds have been found in the slags and flyash of refuse incinerators.
When the discharge of heat from the combustion gasses should lead to an unacceptable level of temperature increase of the sewage water to be cleaned, then partial aircooling of the washwater should be needed.

4. SLUDGE TREATMENT PLANT

After the thicknerer the sludge treatment consists of the following stages:

1. Centrifuges filling pump; This pump takes the sludge from the thickener to the centrifuges.
2. Centrifuges; to thicken the sludge mechanically.
3. Polyelectrolyte supply installation; This injects an amount of flocculant to the sludge just before entering the centrifuges.
4. Screw conveyor; used to take the sludge from the centrifuges to a collection basin.
5. Sludge incinerator supplypump, which takes the sludge from the collection basin to the sludge incinerator.
6. Sludge incinerator consisting of 12 floors with a diameter of 6 meters.
7. Ash chain-conveyor with humidification equipment.
8. Cooling air fan, for cooling the hollow shaft and scraper arms.

Additional equipment like, combustion air fan, induced draught fan, scrubber and stack, were not required as the existing equipment of the refuse incinerator could be used for this purpose.

4.1. Sludge treatment

A part of the excess sludge is returned to the primary sedimentation basins. This surplus sludge settles together with the primary sludge, after which the mixture of primary and secondary (surplus) sludge is pumped to the thickener, by means of a mono-pump. From the thickener the sludge is pumped through a filter and dividers to the centrifuges. Just before entering the centrifuges polyelectrolyte is added. The flocculant assures that the small sludge particles congeal to larger particals, with the result that also these sludge particles are seperated from the water. The volume of the sludge after centrifuging, is about 1/10 of the sludge leaving the treatment plant. The water released in this process is evidently fed back into the sewage treatment plant. After the centrifuge stage the sludge is ready for incineration. The centrifugate from the centrifuges is a neglectable load for the sewage plant.

4.2. Sludge incineration furnace

After the centrifuge stage, the sludge is introduced at the top of the sludge incinerator. This incinerator consists of a circular steel housing with a diameter of 6 meters and a height of 13 meters. With the aid of heat resistant brickwork 12 floors are build up. In the centre of the furnace rotates a double walled hollow shaft. Attached to this hollow shaft just above each storey level hollow arms are fixed. The hollow shaft and these arms are cooled with the aid of a cooling air fan. On the arms, scrapers are mounted which slowly transport the sludge and ash. The sludge is pumped into the furnace on the outside of the top floor. By means of the scrapers the sludge is than slowly moved in the direction of the hollow shaft.
At the top floor there is an opening around the hollow shaft, through which the sludge drops to the second floor.
The second floor is mounted around the hollow shaft without space.