A new W-t-E plant in Antwerp,

A review by Håkan Rylander, Managing Director H Rylander management AB. Former CEO of SYSAV (1996-2014), Past President ISWA (1996-1998), Past Deputy President CEWEP (2002-2014), Former Chairman of ISWA Working Group Energy Recovery (2000-2010), Treasurer of ISWA

Introduction

On commission by Mr Philip Heylen , Chairman of the ISVAG Board, and Ms Kristel Moulaert, CEO of ISVAG, I have been reviewing a proposal of building a new Waste-to-Energy Plant in Antwerp, owned and operated by ISVAG. I have been participating in a number of meetings and technical visits arranged by ISVAG and have also read the report from the consultant company Ramboll in Copenhagen, Denmark on building a W-t-E plant in Antwerp. I have participated in the following meetings and visits together with representatives of ISVAG:

August 29: Meeting in Berlin with Markus Gleis, German EPA. Information about and discussion on "Alternative Techniques for Thermal Waste Treatment".

Agust 30: Seminar in Berlin with presentation of the Ramboll report of a new W-t-E plant in Antwerp by Ole Poulsen,Ramboll, followed by a discussion, with questions and proposals, with participation of professor Silvia Lenaerts, Antwerp, professor Karl Vranken, Antwerp, professor Thomas Christensen, Copenhagen and professor Peter Quicker, Aachen.

Sept. 5: Meeting in Copenhagen with professor Thomas Christensen, DTU, with information about "Environmental Assessment/LCA".
Visit to Vestforbraending in Copenhagen, the largest W-t-E plant in Denmark, with discussions on "Economics for district heating for a W-t-E plant" and with a technical visit to the plant.
Visit to DBDH/Denmark´s District Heating&Cooling Industry Association and to CTR/Copenhagen Heating Transmission Company.

Sept.6: Visit to KARA/NOVEREN in Roskilde and the new W-t-E plant. Presentation of the company, of the new plant and of the project of bulding a new plant, and with a technical visit to the plant.
Visit to Dansk Affaldsforening/ The Danish Waste Management Association for information and discussion about communication when planning and building a new W-t-E plant, public perception etc.
Visit to ARC, Amager Resource Centre, to be informed about the status of the construction of Amager Bakke, a new W-t-E plant.
Meeting with Ole Poulsen and Inger Anette Søndergaard, Ramboll, for a discussions on parts of the report on building a new W-t-E plant in Antwerp.

My review is based upon the above report, discussions , visits and my own experiences.

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Why Waste-to-Energy

ISVAG is planning for building a new W-t-E plant which when taken into operation will replace the present old one, built in1980 and later upgraded in the 1990 íes. Even with a successful waste recycling scheme and with ambitious goals for waste reduction there will be a need for complementary treatment of waste that can´t be recycled, for technical and/or economical reasons, and for residues that sooner or later will be a result of reuse and re-cycling activities. Beside these residues, there are and will be wastes and materials that have to be taken care of and destructed in a safe way, in a "sink", not to jeopardize human health and the environment.
Thermal treatment in a waste-to-energy plant is a well-proven and established technology, with well-proven commercial standard components and solutions to handle these different residues, wastes and materials in a safe environmental way and to utilise the energy content for the production of heat and electricity. There is actually no contradiction between increased recycling and energy recovery. They are completing each other. The countries in Europe with the highest percentage of energy recovery also have the highest percentage of recycling.
The aim must be to minimise the amount of waste, to recycle as much as technically and economically possible and to utilsie the energy content in the remaining waste. With such a concept waste-to-energy is
- good for the climate, with a positive carbon footprint reducing the use of fossil fuels for energy production
- good for the environment, with a well-proven and very well advanced and safe flue gas cleaning and with a correct and safe handling of the bottom ash and the flue gas cleaning residues
- good for energy recovery, with the production of heat and electricity , with the possibility and flexibility to use the heat for district heating and thus considerably improving the economical result.

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There is a landfill ban on household waste in Belgium and landfilling is for many reasons no alternative to waste-to-energy.

Amounts and Capacity

To predict the future amounts of waste is one the most difficult issues within waste manage-ment, especially when designing the capacity of a waste treatment plant. A prognosis must be based upon historical figures but also on goals, ambitions and plans for the future. There are a number of uncertain parameters you have to consider - the number of inhabitants, which in the Antwerp areas are foreseen to increase in the future, the coupling between economical growth and growth of waste amounts, where we in Europe so far haven´t been successful in decoupling the two parameters even if we have very high ambitions, how successful will we be in reducing the waste amounts and how successful will our efforts be to recycle more and more products and materials etc.

There are statistics from Sweden from the early 1920íes up till now, showing an increase in average of the household waste of between 2-3% annually. The average increase is most likely to have been about the same in most countries in at least western Europe. With ambitious goals for waste reduction and aiming for a Circle Economy the increase of the waste amounts most likely will be less in the future. It is very difficult to predict whether there will be an absolute decrease of the present amounts or just a reduction of the present average increase. Even with a successfull recycling there will, as said above, sooner or later be products/materials that can´t be recycled any more and have to be handled as residual waste. It might be risky to build a plant with a capacity based upon today´s waste amounts and with a prognosis that the amounts will decrease. Only 1% increase annually of the amounts will very soon result in an undercapacity, unless the calorific value decreases substantially. Such an undercapacity in combination with contracted deliviries of heat might cause economical and judicial concerns. Also an increase of the calorific value might result in an undercapacity, for example if more plastic waste is delivered to the plant than expected due to a less successful recycling of plastics.

At the visit to KARA/NOVEREN on September 6 there was a discussion on the annual increase of the amounts of household waste and the recommendation from the Deputy CEO, Klaus Hansen, based upon his long term experience was to calculate with at least 1% annual increase, in spite of an increased recycling and the ambitions of waste reduction.

I agree that the conclusion and recommendation from Ramboll - to design the new plant with an annual capacity of 200 000 tons, based upon a thermal capacity of 66 MW, 25 tons per hour at a calorific value of 9,5 GJ/ton of waste and 8 000 hours annual operation - gives a certain flexibility. I can agree with the recommendation, provided that goals and ambitions for waste reduction and recycling are efficiently implemented and successfully fullfilled. However, based upon my long term experience and the arguements above, I would consider to calculate with an 1% increase of the annual amounts of household waste.

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One or two lines

Availability and reliability are two very important and crucial parameters for the successful and safe operation of a plant. In one way or another there has to be a redundancy in case of a short fall of production capacity and also in case of major exceptional unplanned long term critical failure, even if the last case isn´t that very likely to occur in a modern plant. With a large district heating net it will be more economical vulnerable to operate a plant with only one line, but that is not likely to be the case for the new W-t-E plant for many years.
With more than one line you have the redundancy. If you don´t have more than one line you need to have a back up somewhere else, outside the plant. ISVAG has such a back up/redundancy today with a contract with another plant and the possibility to divert waste to that plant in case of a fall of the own production.
Considering the considerably higher Capex and Opex for two lines in stead of one, the high availability in modern plants today and the small likelyhood of any major exceptional unplanned long term critical failures, I agree with the recommendation from Ramboll to

establish the new Waste-to-Energy plant as a single line plant, providing that ISVAG will have a guaranteed long term contract with another plant as a back up in case of operational failures. The same was also the conclusion at the meetings, visits and discussions mentioned above in "**Introduction**".

Waste reception , weighbridge and crane system

I agree with the recommendations from Ramboll concerning a weighbridge with automatic vehicle indentification and registration. I also agree with the recommendation to install a fully automatic waste crane system with two redundant cranes. It has to be observed that even if you have a full automatic system there has to be a possibility for every operator in a shift to operate the crane if necessary, in case of a failure in the automatic system or the necessity to mix the waste even better.

Boiler/Incinerator

I agree with the recommendations from Ramboll concerning boiler/incinerator.

Air cooled grate technology is quite sufficient with the calculated calorific value of the waste. There is no need for a water cooled grate system. By choosing an air cooled system you also avoid the risks of leakage from a wet system.

The choosen steam parameters 53 bar and 425°C are well choosen and, with today´s technology, on the safe side concerning corrosion and with an optimised energy exchange.

Concerning boiler configuration, I have my own experience from the vertical as well as the horizontal configuration and recommends strongly the solution with a horizontal convection part. With a horizontal convection part you will have space, easy access and the possibility of efficient on line cleaning. The vertical solution doesn´t give you these advantages. I also agree with the recommendation from Ramboll with a boiler design with a four pass horizontal steam boiler with 3 empty radiation passes.

I also agree with the recommendation to use inconell cladding in the boiler in combination with minor refractory area for retention time, for lower maintenance costs and for longer operation time between stops,

Concering Boiler Auxiliaries I agree with the Ramboll.

Flue gas treatment

A very well functioning and efficient flue gas cleaning is very crucial and sensitive for every waste-to-energy plant. The present ISVAG-plant has very low emissions and ISVAG expects the new plant to meet the EU-emission directive and the expected BREF-emission limits with good margin.

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The EU IPPC-office in Sevilla, which now is reviewing and considering a new BREF for waste-to-energy plants, is expected to propose an new daily average emission-limit for NOx of 100mg/Nm^3 , which is 100 mg lower than today. To meet with such a demanded highest allowed level you need a considerable margin to handle peak emissions. With a SCR-Catalyst you will be able to meet with these requirements and to do so with a good margin. The catalyst will also work as a "polisher" on the margin for dust and dioxins. Based upon my own very good experiences, the very low emissions of NOx as measured at the Sysav plant in Malmö, Sweden, I strongly recommend the installation of a SCR-Catalyst.

At the seminar in Berlin on Agust 30 Ramboll presented a "Suggested Concept" and four alternative flue gas cleaning systems. The discussion focused on the "Suggested Concept", a semi-dry installation, and on "Alterntive 3, Bicarbonate, SCR Catalyst +Lime absorption", a dry-dry system. After a long discussion among the present professors Ramboll was asked to make a comparison between the semi-dry solution and the dry-dry, alternative 3, with the change in alternative 3 with the ESP taken away and the ECO included in the boiler–circuit for a better energy exchange. The comparison should include the criterias Capex, Opex, energy efficiency, emissions, operation complexity.
At the meeting on September 6 in Copenhagen Ole Poulsen and Inger Anette Søndergaard from Ramboll, presented the comparison, which shows litte difference between the two systems.
Capex turned out to be a little in favour for the dry-dry system, but that will change if you want to reach the same low emission levels on HCl and SO_2 as today in the present plant. In such a case you need more bicarbonate and lime and a larger baghouse filter in the dry-dry system. Opex will be better for the semi-dry system. You will produce more electricity with the dry-dry system but more heat with the semi-dry. The emissions will be lower with the semi-dry system. The semi-dry system is a little more complicated to operate than the dry-dry, but on the other hand the staff at ISVAG is already used to operate a semi-dry system.

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The Ramboll conclusion is that both systems are good with very little difference. There are more references to be found for the semi-dry system, fewer for the dry-dry.
The professors have proposed the dry-dry system, Ramboll has a small plus for the semi-dry system. There has to be a communication between Ramboll and the professors to inform them about the Ramboll comparison, followed by a conclusion which alternative to recommend.
In this process ISVAG must play a key-role by pointing out which criteria or criterias that are the most important one or important ones and to prioritize. As mentioned above, ISVAG expects the new plant to meet the EU-emission directive and the expected BREF-emission limits with good margin and with emissions lower or at least at the same level as at the present plant, with among others emission below 1 mg/Nm^3 for HCl and SO_2. If that is a prioritized criteria for ISVAG the conclusion must be to choose a semi-dry system, in accordance with the proposal from Ramboll. The dry-dry system is not expected to be the same efficient on these emissions.

Residues

The amounts of bottom ash, boiler ash and flue gas cleaning residues are too small for ISVAG to handle alone. The residues have to be handled by external contractors, with the aim to maximise the recovery of metals out of the bottom ash and to ensure the use of the mineral content in the bottom ash for construction purposes.

For the boiler ash and the flue gas cleaning residues there must be long term guarantees from the contractors of a safe and environmentally correct disposal.

Bottom ash has to be kept apart from boiler ash and flue gas cleaning residues as the two last ones are classified as hazardous waste.

Public acceptance

In most countries and cities in Europe there is a public opinion against the location and building of a new waste-to-energy plant. Denmark is the exception which also was shown at the visit on September 6 at Dansk Affaldsforening. The Communication Manager Esben Norrbom confirmed that there always has been very little, if any, public opinion against waste-to-energy.
The key-words and messages have been and are:

- Communication
- Early contacts and meetings with the public
- Transparency, be very open, tell the truth, never lie, give the public answers upon what they ask, if you can´t answer yourself bring in experts
- ”Show who you are”, with plans, drawings, design, what will treated, what is produced, what are the emissons, what are the residues etc

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Esben Norrbom stressed the message that there is no contradiction between recycling and waste-to-energy, they are completing each others. ”We don´t burn what can be recycled”.

The early introduction and installing of district heating in Denmark, as well as in Sweden, has facilitated and even more today,based upon the good experiences, facilitates the building of a waste-to-energy plant. The inhabitants know that they get something useful back from the waste they have delivered to the plant, heat and electricity. Today you can also tell them the positive effect on the carbon footprint, with waste-to-energy the use of fossil fuels is reduced.

District Heating

When delivering waste to a waste-to-energy plant as much as possible of the energy content in the waste should be utilised, as heat and electricity. There is no district heating yet in Antwerp. There is a study on installing district heating going on for the moment, which has

to be completed before any closer plans or prognosis can be presented upon the possibilities and to what extent district heating can be delivered from the new waste-to-energy plant. Undoubtedly, district heating connected to the plant not only would improve the energy recovery and the economy of ISVAG but also the carbon footprint and the public perception about waste-to-energy.
A start could be to deliver heat to a nearby industry or similar with the possibility to expand the district heating to more industries in the neighborhood. At the meeting in Copenhagen on September 6 it was indicated a possibility to a heat delivery of about 150 000 MWh. After that there ought to be good chances to expand the district heating.

Alternative Techniques for Thermal Waste Treatment

Almost every time when the discussions and the plans of a new waste-to-energy start, the discussion of alternative techniques for thermal waste treatment also comes up. Pyrolysis, gasification and plasma technology are techniques that are mentioned with the expectation that household waste can be treated in a very resource efficient and environmentally correct way, with the production and the recovery of gas, heat, electricity and with very limited emissions. A large number of full scale plants have been built around the world for the treatment of household waste with these techniques since the early 1970´ies.

Markus Gleis at German EPA in Berlin and professor Peter Quicker at the University of Aachen in Germany have just recently published a report "Status of Alternative Techniques for Thermal Waste Treatment" (Project No Z 6-30345/18, Report No 29217, Umweltbundesamt in Berlin). In the report they have studied and evaluated almost all projects and plants that have been built since the 1970´ies. At meetings with Markus Gleis and Peter Quicker on August 29 and 30in Berlin they presented the report, the results and the conclusions. Their conclusion is very clear*: None of the mentioned techniques has ever worked and been functioning on household waste.*

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CONCLUSIONS

- Waste-to-Energy is a well-proven and established technique for recovery of heat and electricity out of household waste. There is no contradiction between recycling and waste-to-energy, they are completing each other.

- I agree with the recommendation to design the new plant with an annual capacity of 200 000 tons, based upon a thermal capacity of 66 MW, 25 tons of waste per hour at a calorific value of 9,5 GJ/ton of waste and 8 000 hours annual operation. However, consider to calculate with an 1% increase of the annual amounts of household waste.

- I agree with the recommendation to establish the new Waste-to-Energy plant as a single line plant, providing that ISVAG will have a guaranteed long term contract with another plant as a back up in case of operational failures.

- I agree with the recommendation of a horizontal boiler configuration, air cooled grate technology, inconnel cladding and steam parameters of 53 bar and 425°C.

- For the efficient reduction of NOx I strongly recommend the installation of a SCR-Catalyst, whatever system is choosen for the rest of the flue gas cleaning.

- The two proposed and discussed systems for flue gas cleaning are in all aspects very similar, with very small differences. Both systems, the semi-dry and the dry-dry, are two very good ones. The final communication between the professors and Ramboll will form the conclusion and recommendation. ISVAG must play a key-role in this process by pointing out which criteria/criterias that are the most important one or important ones and to prioritize.
  Involve the operation manager and the operators in the final decision. They have the experiences from the flue gas cleaning in the present plant and must be confident and comfortable with the selected system in the new plant.

- The amounts of bottom ash, boiler ash and flue gas cleaning residues are too small for ISVAG to handle alone. The residues have to be handled in a correct and safe way by external contractors.

- For public acceptance: Communication, Early Contacts, Transparency, ”Show who you are”, ”We don´t burn what can be recycled”, ”You get heat and electricity back” …

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- District heating is an excellent way of utilising the heat produced in a W-t-E plant. Start with deliviries to a nearby industry or similar.

- None of the alternative techniques for thermal treatment of waste – pyrolysis, gasification, plasma technology – has never worked and been functioning on household waste.

- *You have a very good concept! Best of luck!*

Håkan Rylander
September 13, 2016

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