# Advice on Waste-to-Energy installation of the future for ISVAG

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## Introduction

As founder of the research group DuEL "Sustainable Energy, air and water technology" with an industrial career in exhaust and flue gas cleaning I have the opportunity to study the air purification market in depth. Together with members of my team, two assistant professors, two bioscience engineers and five thesis students, we have performed several studies on the gas emissions and impact of the existing waste-to-Energy installation of ISVAG, entitled:

- Assessment of the gaseous emissions of ISVAG.
- Study of the $NO_x$ emissions and contribution of waste burning to the overall emissions in Flanders.
- The waste-to-energy installation of the future.
- Study of the dioxin and PM emissions of waste-to-energy installations and wood burning stoves.
- Energy recuperation in waste-to-energy installations: reduction of $CO_2$ emissions.
- Sustainability assessment of waste transport from remote communities.



Ramboll has performed extensive and high quality study work (11 memo's) and is a renowned authority in the field with a track record of several well performing waste-to-energy installations.

## Situation

It is inevitable that there will always be a portion of waste that, taken everything into account, needs to be burned in a waste-to-energy installation. If you consider the overall impact on men and environment, it is not always sustainable to put a lot of energy in the recycling or re-use of materials. The impact of transport to the environment can't be neglected. All other operations and processes, with their respective energy and material use, man-hours, gaseous and aqueous emissions need to be accounted for.

ISVAG nowadays is a well performing installation with all gaseous emissions far below the emission limit values. Its location near a busy highway with a lot of pollution sources makes the contribution of ISVAG low, as studied in the theses aforementioned.

In the new installation, well-proven technology that is the best in the field should be selected, guaranteeing low environmental and human impact. All gaseous emissions should be as low as possible (which is often below the detection limit), with specific attention to the emissions of $NO_x$, PM, dioxins and mercury.

No water should be discharged to the environment. The amount and toxicity of waste and side streams should be kept as low as possible.

We should aim for a high electrical efficiency with flexible district heating capacity.

## Recommendations

The choice for one instead of two lines is economically and environmentally viable because of the smaller footprint that also allows a green corridor on the terrain. The high availability and reliability of modern waste-to-energy plants justify this choice. Minimum 8000 h per year operational availability can be guaranteed. It should be taken into account that a back-up boiler on natural gas is to be foreseen to supply district heating in case of process shutdown.

The amount of waste to be treated is kept status quo despite the increase of inhabitants. The capacity of 25 ton/h at 9.5 MJ/kg is good and corresponds to the OVAM prognoses for 2020 and 2040. The capacity for Antwerp is 200.000 ton/year, taking into account that waste should be treated as close as possible to the point where it is collected in order to avoid additional exhaust gas emissions caused by traffic movements. Sufficient flexibility is foreseen on variations in the composition of the waste.

Most important is the flue gas treatment system. Air emissions have been a key driver for the selection, aiming for the lowest achievable emissions levels, together with minimum energy penalties and as least as possible waste side streams.

The optimal solution would consist of a constant temperature out of the boiler between 180-230 °C, a bicarbonate/ AC system, bag filter, SCR catalyst, dry lime / AC system in entrained flow, bag house and another economiser to optimize the electrical efficiency of the system. The use of dry lime instead of lime milk, with less water use and better stoichiometric factors for pollutant removal, is preferred over lime milk.

A bicarbonate system allows to capture the pollutants at higher temperature which means the SCR can be placed immediately after the filter and the whole flue gas treatment line is kept at the same temperature between 180 – 230 °C. On top of this the use of bicarbonate reduces the amount of waste by-products.

A double dry system guarantees low emission levels far below the emission limits in Flanders. The main difference between the FGT technologies is that systems incorporating the use of a scrubber ('combined' and 'wet' systems) the emissions of hydrogen chloride (HCl) and sulfur dioxide ($SO_2$) are reduced by higher factors up to 50 times below the EU IED requirements.

The use of an ESP before the bicarbonate is recommendable to have an additional dust removal step. A new generation of ESP uses catalytic coatings that enable additional VOC removal.

All systems have very efficient dust removal capabilities with emission levels reduced from 1.000-2.000 mg dust/$Nm^3$ to around 1 mg dust/$Nm^3$ during normal operation and with good maintenance. Heavy metals are adsorbed on the surface of the dust particles. Therefore, equal removal efficiencies are achieved for heavy metal removal as all systems have the same dust removal efficiency. In order to ensure efficient mercury removal, activated carbon is added upstream the bag house filter, or in the scrubber.

For $NO_x$ removal a selectively catalytic reduction (SCR) is the best available technology in the market and this should be preferred. It has the additional advantage that it removes dioxins/furans and other easy oxidizable organic compounds.

An additional economiser should be introduced in order to get a better economic performance and flexibility towards the district heating system..

We prefer a double dry system, bicarbonate and dry lime with two baghouse filters and a SCR system that has a higher removal efficiency for $NO_x$ and dioxins/furans and a good economic performance while it reduces the amount of waste and by-products. The relatively simple operational requirements allow a smaller number of specialised staff and resources required.

The double filter system, with a catalytic SCR system should guarantee low PM and soot emissions with optimal energy efficiency.

The district heating specifications are very important for the economic parameters of the system, the choice of district heating influences output efficiency. Low district heating temperature should be preferred because it improves the economic efficiency of the waste-to-energy installation; it reduces pipeline thermal stress and maintenance costs.

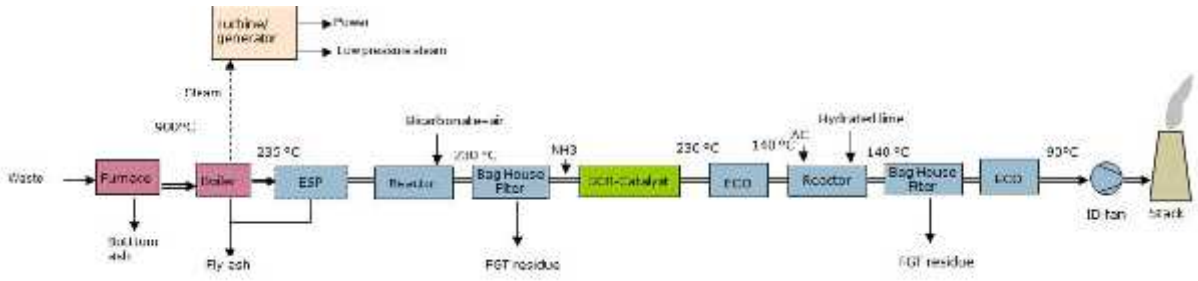
To be able to guarantee the proper operation in case of a system shutdown and to be completely independent the choice for diesel in the backup generator is acceptable.

The additional burners in the oven should preferably be powered by natural gas, the capacity of the grid should be checked in order to guarantee that there is enough gas available, because operation of these burners on diesel increases the emissions of the system. If this is the case it should be guaranteed that the additional emissions are fully captured in the flue gas treatment system.



## Conclusion

Taken the above into account my preference goes to alternative 3 in the Ramboll report dated September 12th:




The proposed waste-to-energy installation uses the best available technology that guarantees low emissions with specific focus on PM, NOx, dioxins/furans and mercury, high electrical efficiency, the flexibility for district heating, low technological complexity and the minimum amount of waste streams.