

## Salts recovery from MSW incineration residues

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In order to promote sustainable development, the solid residues produced by municipal solid waste incineration must be properly managed. The reduction of the amounts of ultimate solid residues can be done by lowering their production and their valorization.

On the contrary of lime processes producing calcium salts which are not recyclable, flue gas cleaning with neutralization of acids by sodium bicarbonate (NEUTREC® Process) produces sodium salts which can be recycled after purification.

The purified sodium salts are recycled in a SOLVAY soda ash plant as a substitute for one of the raw materials used to manufacture sodium carbonate allowing the completion of the sodium cycle.

### 1. SUSTAINABLE DEVELOPMENT AND RESPONSIBLE CARE

Sustainable development is one of the biggest challenges facing industrialized countries at the turn of the 21<sup>st</sup> century.

Responsible progress will in future include :

- preserving natural resources;
- protecting the environment;
- managing all waste flows in an ecologically acceptable manner.

Solvay's Responsible Care® programme appropriately reflects this awareness. Industrial Companies must formally commit themselves to adopting all necessary measures to ensure that their performances in the field of safety, health and environmental protection continue to improve.

Solvay's new technologies provide a concrete answer to point 5 of its Responsible Care® programme : "to take into account what happens to our products after use, to encourage recycling and promote correct disposal".

### 2. WASTE MANAGEMENT AND CLEAN INCINERATION

Europe produces 120 million tonnes of Municipal Solid Waste (MSW) every year, three quarters of

which are dumped in landfill sites. Despite increased recycling of plastics, glass, paper and metals, the amount of waste to be disposed of has further increased over the past ten years.

In parallel with this increase in MSW, the area of land available for waste tips is constantly shrinking and environment protection standards are becoming stiffer and stiffer.

There are three solutions to the problem of waste disposal and dumping :

- produce less waste;
- promote selective collection and recycling in all its forms;
- develop clean incineration.

MSW clean incineration generates solid residues :

- the bottom ashes at the outlet of the combustion chamber;
- the fly ashes collected below the boiler and in an electrostatic precipitator (in case of only dedusting);
- the flue gas cleaning residues resulting of the acids neutralization and collected in a baghouse filter, together with the fly ashes.

Bottom ashes are dumped as they are. The flue gas cleaning residues are composed of fly ashes and salts, mostly calcium based, which are not recyclable and are dumped, after inertization in France and Italy.

The flue gas cleaning with sodium bicarbonate produces sodium salts which are recyclable, allowing the recuperation of raw materials. This Solvay's new technology is described hereafter.

### 3. THE NEUTREC® PROCESS FLUE GAS CLEANING

The NEUTREC® Process flue gas cleaning system (Figure 1) is based on injecting finely ground dry sodium bicarbonate into the flue gases to be purified. It is applied on an industrial scale since 1991.

The sodium bicarbonate neutralizes the acids (hydrochloric acid, sulphur dioxide, etc.) with a very great efficiency.

Heavy metals and dioxins/furans are removed by adding activated carbon or lignite coke to the sodium bicarbonate. This reagent combination meets the most stringent legal standards :

- directives 89/369/EEC and 89/429/EEC (MSW incineration);
- German standard 17.BImSchV (MSW and assimilated combustible materials incineration);
- directive 94/67/EC (hazardous waste incineration);
- future Council directive on the incineration of waste.

The products of the acids neutralization are sodium salts (sodium chloride, sodium sulphate, sodium carbonate, etc.), called Residual Sodium Chemicals (or RSC). These are then filtered out of the flue gases.

As the process is totally dry, there is no aqueous effluent produced, nor to be treated.

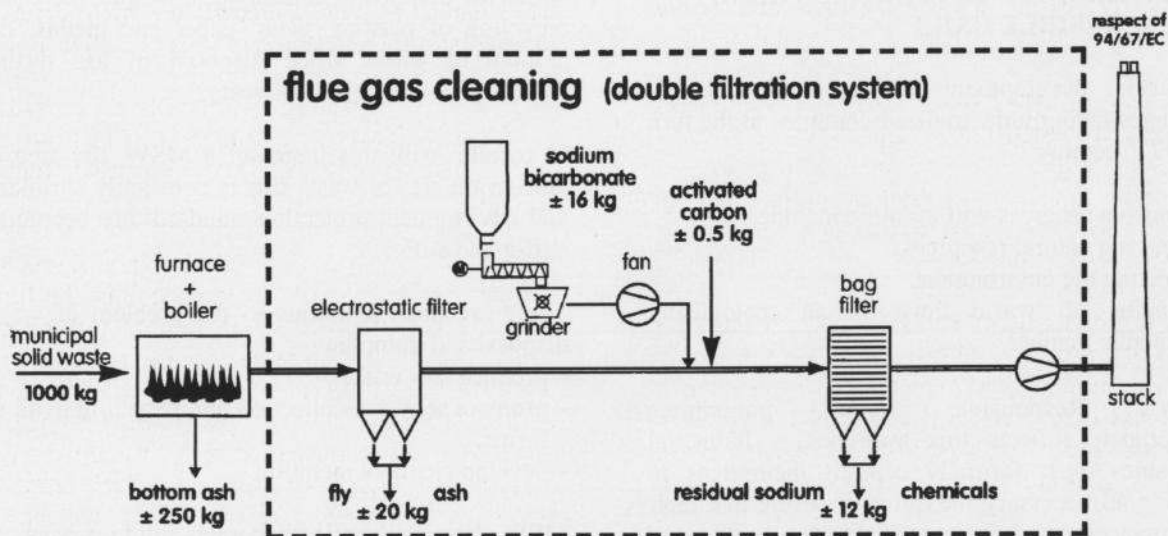


Figure 1. The NEUTREC® Process flue gas cleaning.

#### 4. TREATMENT AND RECYCLING OF THE FLUE GAS CLEANING RESIDUES

The NEUTREC® Process offers a solution for disposing of flue gas cleaning residues other than dumping on landfill sites : in most cases their sodium base and the available technologies enable them to be purified and recycled.

Solvay has developed and industrialized processes for purifying residues from the purification of flue gases. These processes produce salts which are recycled in Solvay's plants as a substitute for one of the raw materials used to manufacture sodium carbonate.

In the case of municipal and hospital waste incineration and where a two-step filtration is used for flue gas cleaning (see Figure 1), the RSC collected at the second filter consist mainly of sodium chloride, sodium sulphate and sodium carbonate. They also contain impurities such as part of fly ashes, activated carbon and heavy metals.

As part of the NEUTREC® Process, Solvay has developed, patented and industrialized an original technology which makes it possible to produce a NaCl brine with a level of purity that allows it to be recycled as a raw material substitute in sodium carbonate production units.

The RSC are dissolved in water at a controlled pH and with certain additives. The suspension resulting from this operation is passed through a filter press which separates the insolubles : heavy metal hydroxides, activated carbon and fly ashes. In this way, a raw brine and a cake are obtained.

The raw brine is then passed over activated carbon in order to absorb any remaining organic component. Final traces of heavy metals are eliminated by passing over ion exchange resins. The perfectly purified brine is then ready to be injected into the sodium carbonate manufacturing process.

The filtration cake, which is the only ultimate waste, is tipped on an approved landfill site. The total amount is no more than 2 to 4 kg per tonne of incinerated MSW.

Internal recycling of all the washing and regeneration fluid from the ion exchange resins means that no aqueous effluent is produced, only recyclable brine and the filtration cake.

This technology is implemented at industrial scale at the Rosignano unit operated by SOLVAL®, a Solvay subsidiary, since April 1998.

#### 5. THE ROSIGNANO RESIDUAL SODIUM CHEMICALS PROCESSING UNIT

The Rosignano industrial pilot plant (Figure 2) has a processing capacity of 2,800 t/year of residual sodium chemicals from incinerators fitted with the NEUTREC® flue gas purification process.

The residual sodium chemicals are transported to the site by truck and stored in silos ( $2 \times 40 \text{ m}^3$ ).

The RSC (350 kg/h) are dissolved in water (1,000 kg/h) in two dissolvers ( $1.2 \text{ m}^3$ ) in the presence of specific additives for heavy metals precipitation.

The slurry formed in this way is passed through a press filter ( $32 \text{ m}^2$ ) which separates out the brine from the insoluble matter and from the precipitated heavy metals. The filtration cake (40 to 50 kg/h) is eliminated on a licensed landfill site. The brine collected in the filter then passes through a sand filter and an activated carbon column which absorbs the organic compounds which may be present. The final traces of heavy metals are eliminated in two ion-exchange resins columns in order to achieve a grade of NaCl brine compatible with the Solvay soda ash process.



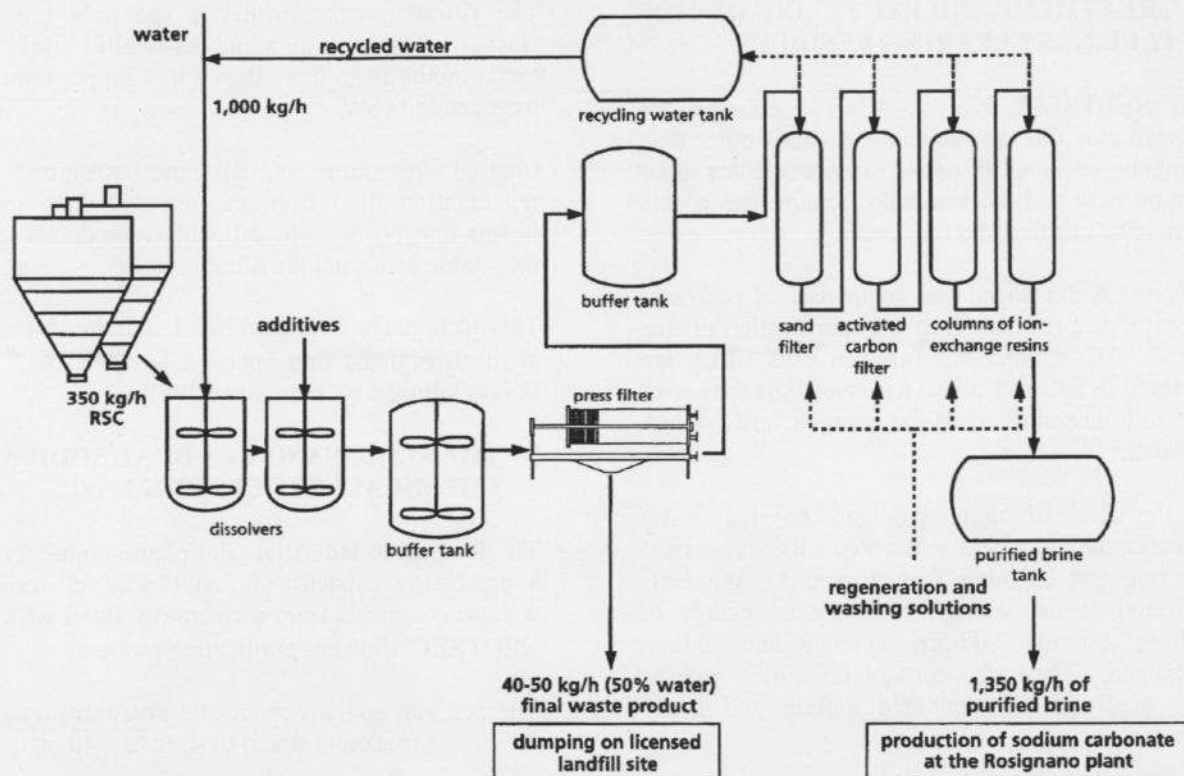


Figure 2. Diagram of the purification unit for Residual Sodium Chemicals (RSC)

The purified brine and the filtration cake are the only end products. The washing water, the resin regeneration reagents, etc. are fully recycled in the dissolvers. In other words the plant does not produce any aqueous waste. A purified saturated NaCl brine is produced. This brine is then piped to the neighbouring Solvay plant, where it is mixed with the saturated brine used for the production of sodium carbonate at Rosignano.

On arrival at the plant, the RSC are analyzed to check that their composition matches the acceptance specifications of the Rosignano RSC purification unit.

The purified brine produced by the installation is regularly analyzed for conformity with specifications before being sent on to the sodium carbonate production plant.

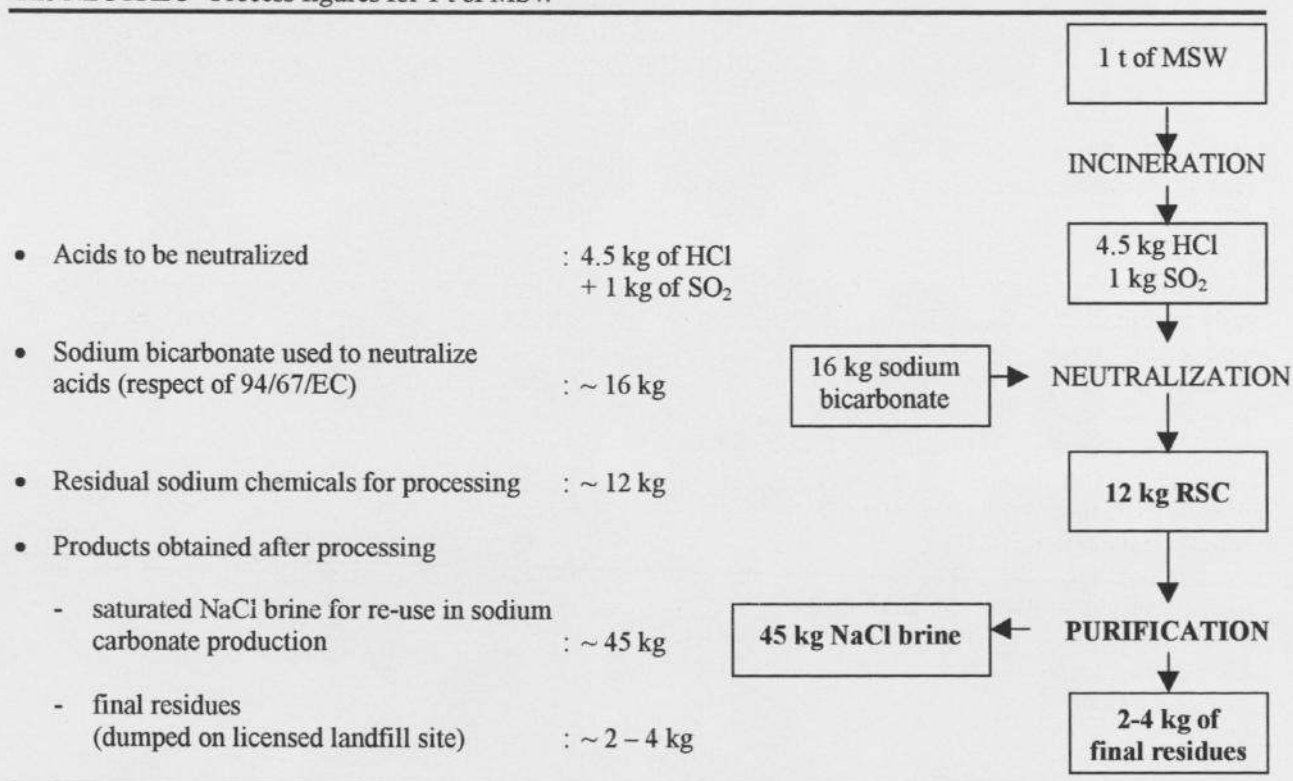
By way of example, Table 1 presents features of the RSC for processing and of the purified brine.

Table 2 presents the figures for the NEUTREC<sup>®</sup> Process based on the incineration of 1 tonne of municipal solid waste (MSW).

Table 1  
Features of the RSC for processing and of the purified brine (typical values)

	Composition of the RSC Typical values	Composition of the brine Typical values
NaCl + Na <sub>2</sub> SO <sub>4</sub> + Na <sub>2</sub> CO <sub>3</sub> (% dry wt)	90	95
NaCl (% dry wt)	65	70
Na <sub>2</sub> SO <sub>4</sub> (% dry wt)	10	10
Na <sub>2</sub> CO <sub>3</sub> (% dry wt)	15	15
KCl (% dry wt)	2	2
Insolubles (% dry wt)	4 – 8	< 0.004
Al (mg/kg dry product)	1,800	4
Cr (mg/kg dry product)	35	< 0.4
Cu (mg/kg dry product)	480	< 0.4
Hg (mg/kg dry product)	95	0.2
Pb (mg/kg dry product)	2,600	4
Zn (mg/kg dry product)	6,200	< 0.4

Table 2  
The NEUTREC® Process figures for 1 t of MSW



## 6. CONCLUSIONS

The NEUTREC® Process guarantees the respect of the environment.

Being entirely dry, the NEUTREC® flue gas cleaning process produces only solid residues. Unlike in wet processes, there is no aqueous effluent and no discharge of liquids into the environment.

The NEUTREC® RSC purification process produces no liquid effluent. The only outgoing flows are recyclable NaCl brine and the filtration cake.

The sodium salts contained in the flue gas cleaning residues are fully valorized, as a substitute for one of the raw materials used to manufacture sodium carbonate, allowing the completion of the sodium cycle.

The high degree of efficiency of the reagent and the process minimise the quantity of residual sodium chemicals. The sodium nature of these products means that they can frequently be recycled (after purification), thereby minimising consumption of non-renewable resources and also the amount of final waste to be dumped on landfill sites.

The purified recycled NaCl brine presents characteristics equivalent to the ones of the raw brine used in the soda ash plant.

The RSC purification unit promotes sustainable development by contributing without delay to the responsible management of non-renewable natural resources.