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# Acid fly ash wash FAW by AIK

# incl. wastewater treatment

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# FAW by AIK
## Acid fly ash wash

The FAW (fly ash washing) process, which was developed at the beginning of the 1990s, is optimally suited to wet waste gas treatment This process enables heavy metals to be recycled and minimizes the amount of residual material to be deposited in landfills.

The acid fly ash washing process uses the acid present in the blowdown from wet flue gas cleaning to extract the mobilizable metals in the ashes. In the first step, the mercury contained in the wash water is separated by adsorption on a selective ion exchanger and is simultaneously concentrated (AIK mercury ion process). To achieve the highest possible loading of the ion exchange resin, the wash water is filtered and thus freed from the solids still present.

The extraction of the heavy metals from the fly ash takes place in a stirred tank cascade, whereby the ash is suspended in the wash water. The pH value is adjusted to an optimum, plant-specific value. The heavy metals largely go into solution at this pH, while matrix elements (aluminum oxide, iron oxide, silicon oxide) remain predominantly in the solid. In addition, gypsum is formed and precipitated by the reaction of the sulfate-containing wash water with the calcium of the fly ash and the lime milk added for pH control.
The removed solids are drained on a support belt filter and rinsed by a displacement wash. In Switzerland, this residue complies with the guideline for the disposal of residual substances (Eluate testing) and can be deposited as landfill together with the slag.

The solution containing heavy metals is fed to the wastewater treatment plant (WWT). The hydroxide sludge is drained, rinsed and thermally post-dried in the WWT. Thanks to the high concentration of zinc and the extensive pre-separation of unwanted accompanying substances (calcium sulfate, mercury, chloride), this material is suitable as a secondary raw material for zinc production.

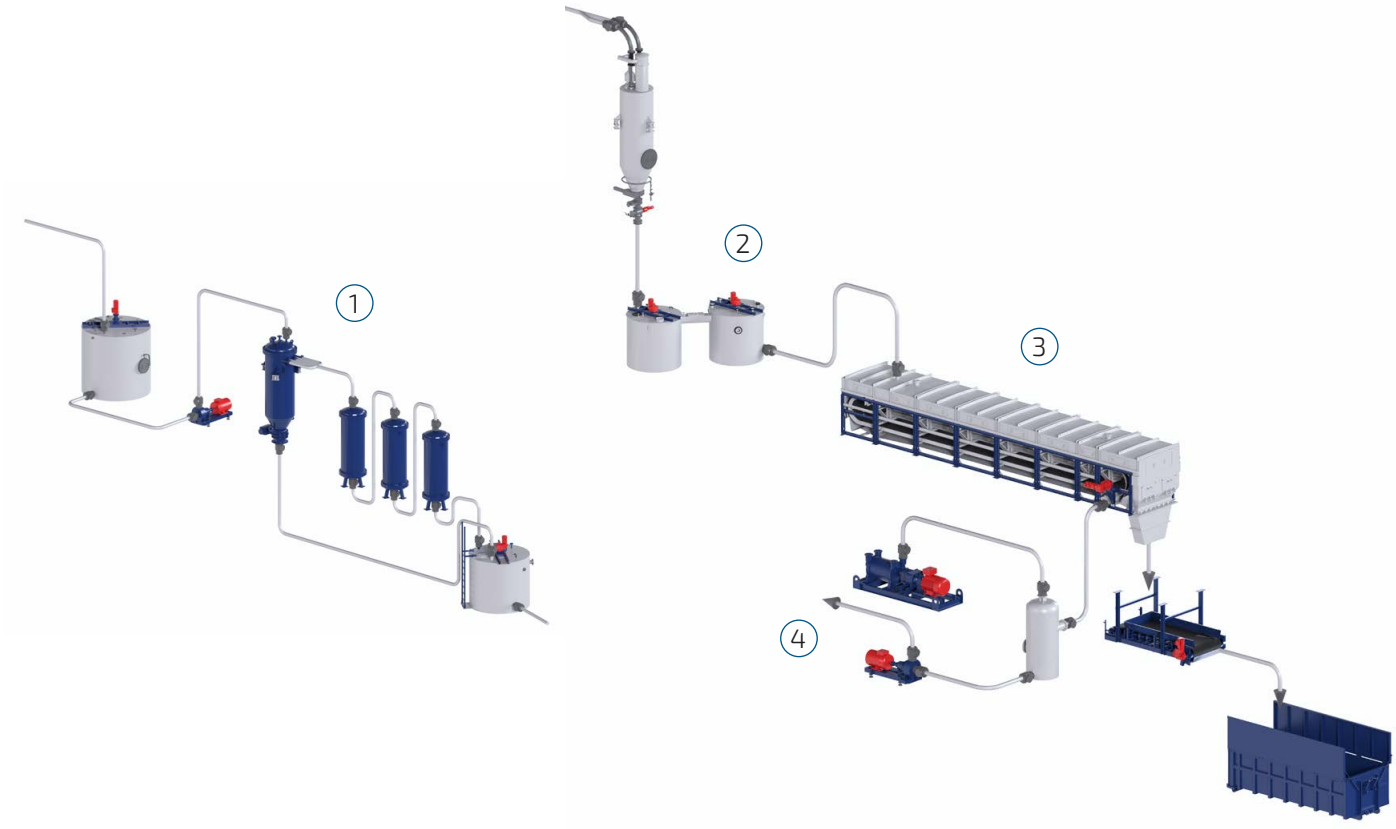
# Process engineering and procedural sequence

The FAW process treats 100% of the filter ash load generated throughout Switzerland. According to the motto „recycling before landfilling“, the FAW process enables the recycling of heavy metals and minimizes the amount of residues to be landfilled.

**Step 1: Selective mercury separation**
The solid matter still contained in the wash water is filtered off via back-flushable cartridge filters in order to achieve the highest possible loading capacity for the mercury in the subsequent ion exchanger.

The mercury dissolved in the wash water is completely separated in series-connected selective ion exchangers and fed to the recovery system.

**Step 2: Extraction of the fly ash in a stirred tank cascade**
The alkaline fly ash is suspended in the acidic wash water. The mobilizable heavy metals of the fly ash are dissolved. By adding a small amount of an oxidizing agent (e.g., $H_2O_2$) a high extraction yield.
The calcium ($Ca^{2+}$) contained in the fly ashes reacts with the sulfate ($SO_4^{2-}$) contained in the wash water to form poorly soluble gypsum.



# Process engineering and procedural sequence

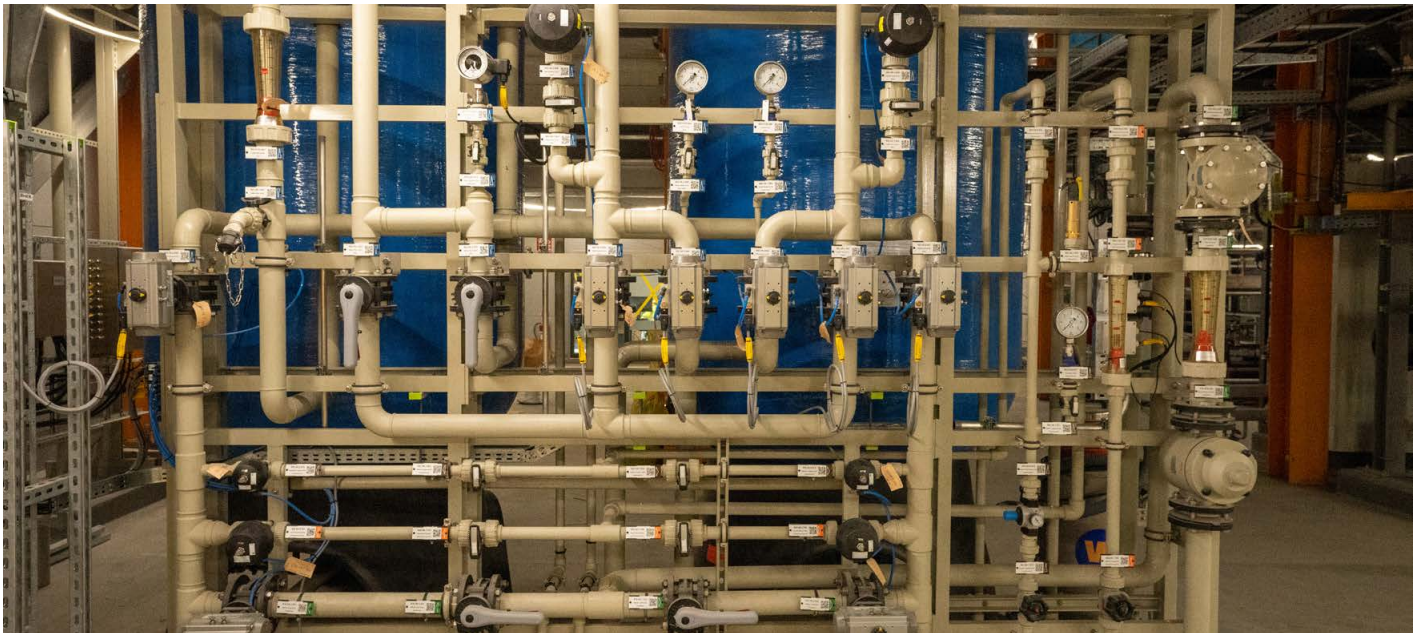
FAW by AIK is a registered AIK process developed by AIK Technik AG. With our knowledge, we have already been involved in many FAW plants all over the world. We would be happy to find the right solution for you as well.

**Step 3: Drainage and post-treatment of the extracted residues**
The suspension from the last extraction vessel flows directly onto a vacuum belt filter. This filter causes a mechanical separation of the liquid from the suspension phase. Under the influence of vacuum, the liquid phase largely separates from the solid phase. A compact ash cake is formed. This contains salts dissolved in the residual moisture and heavy metals, which are washed out by displacement washing. The resulting wash filtrate is collected in the filtrate separator and fed for further treatment to the downstream wastewater treatment plant (WWT) for residual neutralization and heavy metal precipitation.

The fly ash can now be delivered with the slag to a landfill (in Switzerland).

**Step 4: Wastewater treatment and separation of the hydroxide sludge**
The wastewater containing heavy metals is purified by hydroxide precipitation. This is usually done with lime milk. The hydroxide sludge is thickened by a candle filter and drained by a fully automatic membrane chamber filter press and, if desired, thermally post-dried. Post-drying is economically interesting in order to save transport and energy costs, for example in a zinc recycling process. The last traces of heavy metals are removed from the filtrate by downstream selective ion exchangers.

Read more about this on the following pages 6 and 7.



# Sustainable waste policy and AIK Technik AG

The matrix elements of the flue specks of dust are deposited together with the slag. By separating the water-soluble salts and the heavy metals, the quantity (as dry matter) and the environmentally hazardous potential is greatly reduced.

The FAW process is an effective method for the treatment of residual materials. The application of the technique is particularly recommended for waste incineration plants. The treatment washes the ash with acid and thus extracts the valuable recyclable raw materials.

In Switzerland, approx. 4 million tons of waste are recycled each year. Of this, an average of 800,000 tons of slag and 80,000 tons of fly ash are produced.

The mercury is separated in the flue gas cleaning system, from where it enters the wastewater treatment system, where it is removed by the AIK mercury ion process. A considerable amount of zinc is also extracted from the flue dust and recycled. A further proportion is found in the slag.
Likewise, due to its volatility, about 75% of the cadmium can be found in the flue dust. Most of this can be recycled together with the zinc.

It is precisely these 2 elements that achieve the highest recovery rate of recyclables in a waste incineration plant with an integrated FAW process.

In the overall material or substance balance of urban areas, it is primarily the highly toxic heavy metals mercury, cadmium, and lead, which to a large extent find their way via the waste and thus into the incinerator.

Since 2016, Municipal Solid Waste Incinerators (MSWIs) have been required to acid-wash fly ash to meet the requirements for disposal in landfill D.

# The necessity of wastewater treatment

Wastewater treatment is an important part of waste incineration, as well as in many other industries where water is needed. In many plants, the wastewater is cleaned of pollutants so that it can be reintroduced into the process cycle or discharged into surrounding bodies of water.

Municipal Waste Incineration Plants (MWIPs) are modern facilities used for the effective disposal of waste. The technology of thermal waste treatment offers many advantages. The amount of residual waste materials that needs to be landfilled is massively reduced, and the heat generated is used to produce energy (electricity and district heating). However, there are also some challenges in the use of waste incineration plants, especially with regard to the treatment of exhaust gases, wastewater, and residual materials.

An important component in a municipal solid waste incineration plant is the wastewater treatment plant (WWT), which is used to treat the wastewater generated during the cleaning of the flue gas before it is released into the environment.
The wastewater treatment system consists of several stages such as neutralization, sedimentation/thickening, filtration, and ion exchange columns and/or activated carbon filters.

Overall, fly ash washing and wastewater treatment are important components in wastewater incineration plants that help minimize emissions and environmental impacts. Careful design, planning, monitoring, and maintenance of these systems is a prerequisite to maximize performance and effectiveness.

# Process of the wastewater treatment

Wastewater treatment in incineration plants is important because it ensures that the wastewater is free of pollutants. This is necessary to protect the environment and to safeguard human health.

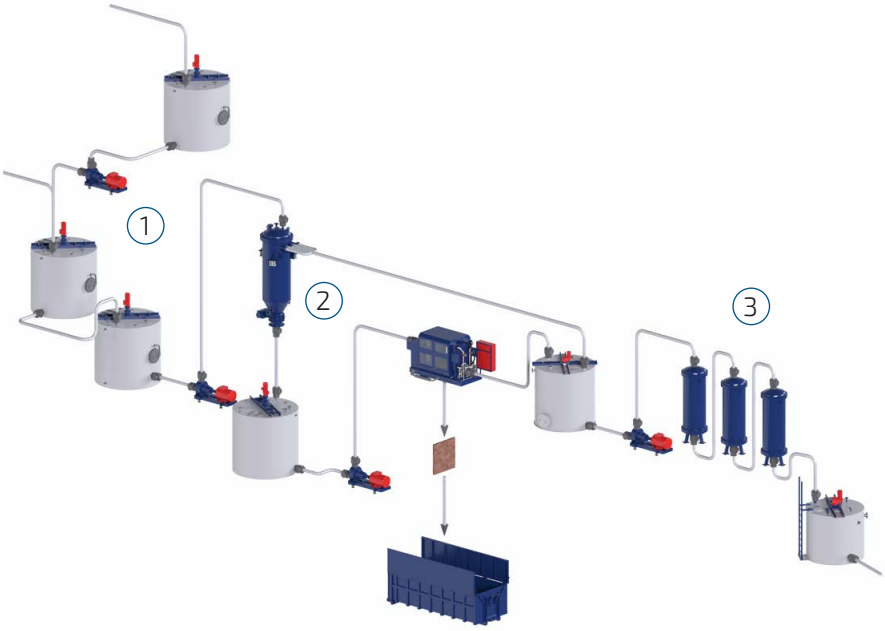
The plants must be designed in such a way that they operate effectively and reliably. There are various processes that can be used in waste incineration plants. We offer chemical wastewater treatment plants, taking into account the type and concentration of the pollutants they contain. The processes are based on the separation of solids and liquids, and the addition of chemical reagents to remove the pollutants in the wastewater. Chemical reagents can be different chemical agents.

The waste or garbage that is incinerated in a municipal waste incineration plant (MWIP) contains many different chemical compounds. To ensure that the wastewater cleaned by the MWIP meets quality standards, it must undergo several different cleaning treatment steps.

**Step 1: Neutralization**
The wastewater from the FAW is initially fed into a stacking tank. Then, the sludge-water mixture is neutralized with lime milk.

**Step 2: Total filtration**
The sludge is separated with a candle filter and a membrane chamber filter press so that the water from which the sludge has been removed can pass to the next process step. From the candle filter, the thickened sludge is further processed in the filter press, where the sludge is pressed and drained.

**Step 3: pH reduction, heavy metal separation, and final measurement**
The pH value is then lowered so that the ion exchangers can work better. Heavy metals are separated from the water via several ion exchanger columns and bound together using selective ion exchanger resin. After this, the pH value is checked again and adjusted if necessary. Finally, the water is clean and can be returned to the water circulation system.



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