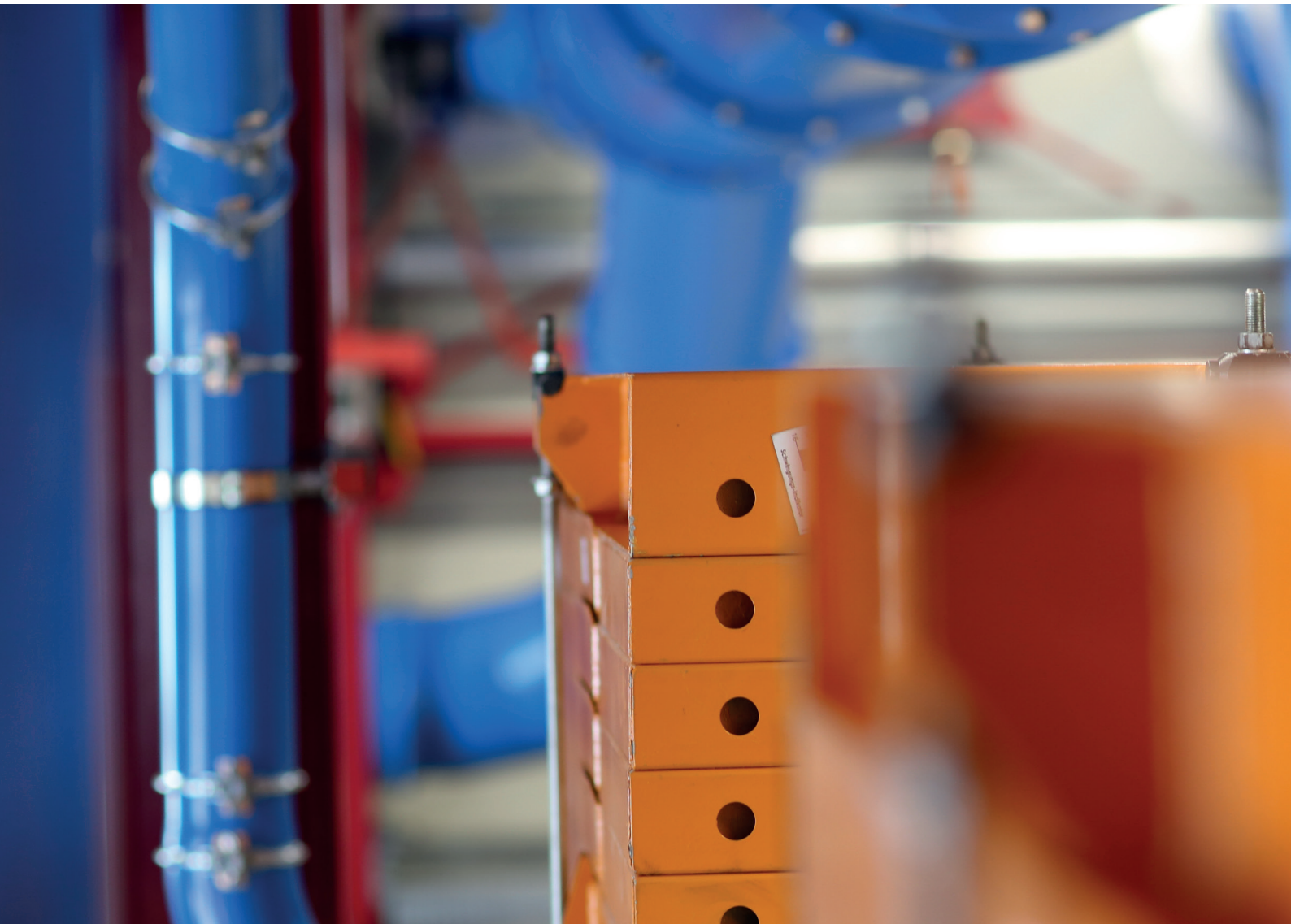
STIFTUNG ZENTRUM FÜR NACHHALTIGE ABFALL- UND RESSOURCENNUTZUNG

Waste and Resource Management

innovative, ecological, economical

Annual Report/Activity Report 2017



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◀ Processing plant of ZAV Recycling AG

Foreword by the President

The name of our foundation – «Center for Sustainable Use of Waste and Resources» – clearly indicates that the development activities of the foundation are a never-ending process. Once a goal has been achieved, it immediately becomes an interim goal, and there is nothing more volatile than the so-called «state of the art»: once achieved and acknowledged, our ambition is to raise this level further.

Why don›t we just rest on our laurels and be satisfied? It is obviously implanted in human nature to seek out new experience and to innovate. Even if this is basically very positive, many technicians and engineers waste time and money on absurd and inhuman goals. Above all further developments in weapons technology, which serve the sole purpose of destroying people and infrastructure, and to help individual despots to power and wealth.

Despite my age, I am not pessimistic, on the contrary: despite all undesirable developments, it is particularly characteristic for the framework of our foundation to proceed with small pragmatic steps to counter the inevitable effects of our affluent society in the best possible way. This is unspectacular progress, in particular since it is not driven by purely economic interests.

I would like to express my respect and gratitude to all those who are pursuing this demanding path, as well as to all those who provide our team with advice and financial support. I am convinced that both the driving and shock forces in the ZAR Foundation will not fade, because there is still a lot to do!

Dr. Ueli Büchi
President of the Board of the Foundation

BOTTOM ASH TREATMENT

Optimization of material feed to non-ferrous separator

Operational experiences

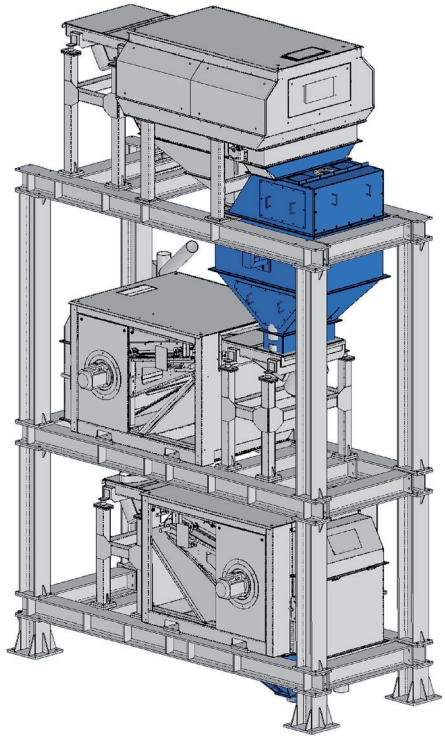
During the quality control of non-ferrous metal particles (NF-metals) of the fraction 0.3–2.0 mm frequent measurements indicated that the mineral content in the non-ferrous metals varies significantly despite constant settings of the eddy current separator (non-ferrous separator). This can be explained as follows: With the current plant configuration, the fine bottom ash 0.3–12.0 mm is constantly feed onto a screening machine, which in turn feeds the two non-ferrous particle separator lines of 0.3-2.0 and 2.0-12 mm. Since the bottom ashes are processed by five different plants, the bottom ash itself is a very inhomogeneous raw material and sedimentation occurs in the storage silo, leading to a continuously changing particle size distribution. This also effects the feeding of the non-ferrous separators, although the throughput is kept constant over both lines.

Conclusions

Long-term observations have shown that this can cause operating conditions to variate so strongly that, depending on the particle size distribution, the feeder line may receive too much material and thus no longer guarantees a clean separation of non-ferrous metal particles and the bottom ash.

Measures

To solve this problem, it was decided to install a smaller storage silo in front of each of the two NF-separators so that both lines can be fed constantly. Initial tests show that the mineral content has decreased and is at a more constant level.



▲ Buffer silo

Results

We expect the following advantages for operation from the modification:

- Qualitatively better sieving
- Slightly increased efficiency in non-ferrous separation
- Constant proportion of mineral bottom ash in non-ferrous metals
- Improved adjustability of the non-ferrous separators
- Slightly increased throughput of the system

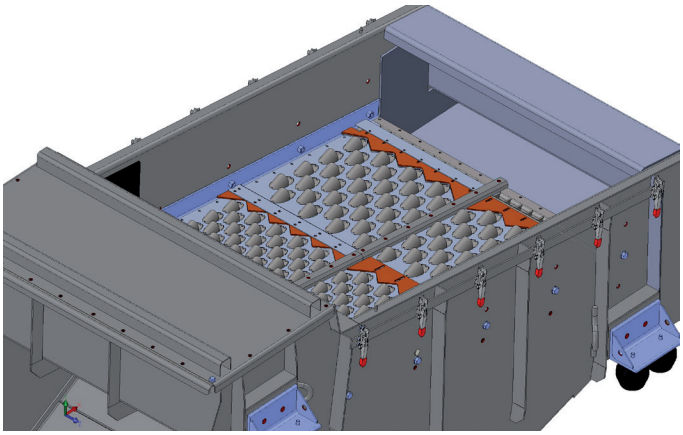
Nose screen

Operational experiences

The “double-nose-screen” developed by the ZAR team in 2015 has proven itself in operation in terms of fractionation, maintenance and service life. However, when used as a “police screen” after the crusher to separate the missed inox parts, it was discovered that the inox fraction also contained additional fine bottom ash particles. The analysis has shown that a small proportion of the bottom ash grains find their way through the sieve without being separated

Measures

Since the bottom ash to be sieved contains a large number of wires, a construction is required for use as a “police sieve” in which it is not possible for the wires to hang in wires.



▲ Modified double-nose-screen

Results

With the new design, the short-circuit currents across the screen were eliminated and no blockages were observed due to the adjustment. This modification is now be used for the other double nosed screens.

Abrasion

Operational Experience

The unexpectedly high level of metal abrasion in the plants and at material transfers due to dry bottom ash causes a great deal of maintenance work. Unfortunately, there is no patent solution for this problem.

Measures

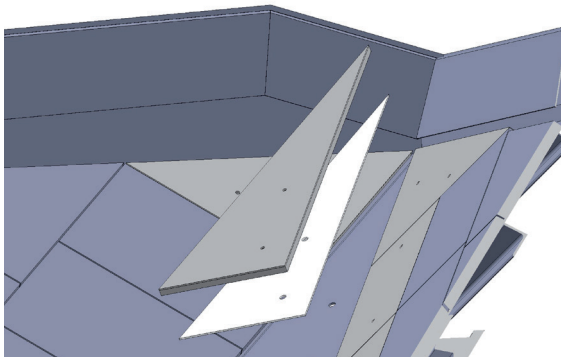
More and more material pockets were installed, which is by far the most favorable measure against abrasion. However, the material pocket can also hinder the material flow and lead to blockages. Therefore, it cannot be used everywhere. In addition, various materials were tested very intensively for their abrasion properties.

Results

In summary, the measures resulted in significantly longer service lives, whereby the various bottom ash flows require various measures.

Bottom ash larger than 12 mm:

Abrasion plates were mounted on insulating rubber plates. With Castolin Eutectic materials and specially clad plates from company Martin, an umpteen times increase in service life has been achieved.

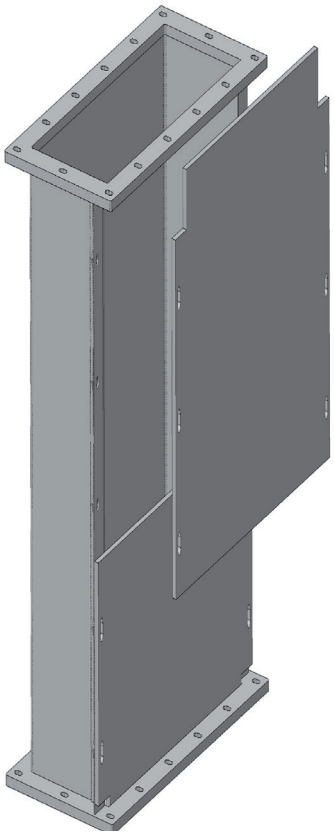


▲ Abrasion plates

Bottom ash smaller than 12 mm:
With fine bottom ash the best experiences were made with polyurethane (PU). To avoid unnecessary downtimes due to the curing time of the PU, PU plates were glued to metal plates and these were screwed into the material channels.

Furthermore, the existing material channels were replaced at very critical points by a new channel system, which enables rapid replacement of worn abrasion plates.

The entire plant is now to be gradually upgraded with the improvements mentioned above. Due to the size of the plant, the complete conversion will take several years.



▲ Channel system with quick-change device

Ion treatment

Operational experience

The iron processing plant had to be shut down after only a short operating phase. The large number of big magnets in the iron fraction repeatedly led to massive blockages, so that continuous operation of the iron sorting system was not possible. This also prevented subsequent manual sorting.

Measures

After various modifications of the most critical processing points, the processing plant was back in operation at the end of the year.

Results

Today, continuous manual sorting is carried out. Initial analyses show that the copper content of the processed iron can be significantly reduced by manual sorting. This increases the quality of the retrieved iron materials which provides a guaranteed acceptance by the smelting plant and better yields.

Stainless steel separator

Operational Experience

Despite extensive software adjustments to the stainless-steel separator, neither the specified efficiency nor the maximum proportion of non-ferrous metals in the stainless steels fraction were met. At present, it is also not foreseeable that the supplier will be able to provide a solution to the problem. Since the systems are integrated into a system, however, a change of supplier is currently not possible easily.

Measures

Trials at another manufacturer with a different sensor and a different blow-out unit have shown that the efficiency could be improved. The objective of the foundation ZAR to produce a marketable inox product does not yet seem possible even with the competitors product.

Results

The fact that the number of bottom ash agglomerates in the coarser fractions (30–80 mm) is large means that the resolution of the sensors or the type of sensors or the algorithms used are insufficient to distinguish between a pure inox part and a bottom ash agglomerate with some iron.

Consequence

Until a sustainable solution can be found, we must come to terms with the current situation, which has the following consequences:

- No sale of high-quality inox material
- Less yield for non-ferrous material
- Monitoring of the plant during discontinuous operation

We are in discussion with the machine supplier about equipping a machine with a new sensor and blow-out unit for testing purposes, so that tests can be carried out over a longer period of time and better principles for further action can be worked out. We assume that the trials can be started in the 2nd quarter of 2018.

We are aware of the complexity of the raw material bottom ash, but at the same time we have to realize that the separation of VA metals from bottom ash has not yet been sustainably solved by the machine suppliers. Currently it appears that more development work will have to be carried out to achieve satisfactory results.

The fact that the proportion of VA metals in waste will continue to increase means that the separation of VA metals will become even more important for the environment, which in turn justifies further development efforts.

Share of non-ferrous metals in the magnetic bottom ash

Operational experience

Measurements have shown that the non-ferrous component in the magnetic bottom ash is surprisingly high. This means that some of the non-ferrous metal particles smaller than 12 mm are discharged with the magnetic bottom ash before reaching the non-ferrous separators and cannot be separated.

Measures

Attempts to reduce the magnetic strength using a much thicker conveyor belt have shown initial positive results. However, it was also found that even with thicker conveyor belts the magnetic effect is still too strong and the magnetic drums therefore have to be replaced.

The conversion of the magnetic drums results in a significant reduction in the proportion of magnetic bottom ash and a significant increase in the proportion of processed bottom ash.

However, since ZAV Recycling AG residual bottom ash silos are fed on a product-specific basis, the silo volume for the processed bottom ash would be much too small to justify operating the plant continuously over the weekend. This means that the non-ferrous metal potential in the magnetic bottom ash can only be realized when the material flow in the plant can be modified to a greater extent

PHOSPHORUS RECOVERY

With the construction of a central sewage sludge recycling plant (KSV) at the Werdhölzli site in Zurich in mid-2015 it was decided to use the sewage sludge as a source of phosphorus. This initiated research and development for a marketable technical process for phosphorus recovery from sewage sludge ash.

The ZAR Foundation's Hydrometallurgy Competence Center was commissioned with the necessary research and development work. In 2013 after several years of experience and corresponding results, the decision was taken to produce phosphoric acid as an end product of the processing plant instead of fertilizer raw material.

Together with the Spanish development partner and plant manufacturer Técnicas Reunidas S.A. (TR), the «Phos4life» process was launched. It can be used to produce a technically pure, heavy-metal-free, commercial phosphoric acid. Compared to today›s conventionally produced phosphoric acids from raw phosphates, the environmental impact of Phos4life acid is significantly lower.

Piloting of Phos4life® successfully completed

With the successful pilot phase, the last major development step of the Phos4life process has been completed. This was put through its paces with continuous coordinated testing of all the key process steps. For this purpose, the pilot plant was operated 24 hours a day from Monday to Friday. All key process parameters were documented, evaluated and supplemented with chemical analyses of all material and product flows.

The measured results were continuously fed back into the process optimization and operation of the pilot plant. The positive results confirm the test results of the previous laboratory phases.

The performance of the Phos4life process could be demonstrated under industrial conditions. The high targets achieved for the efficient recycling of sewage sludge ash, the consistently high product qualities with an unproblematic sales market and a robust process technology are the keys to our success.

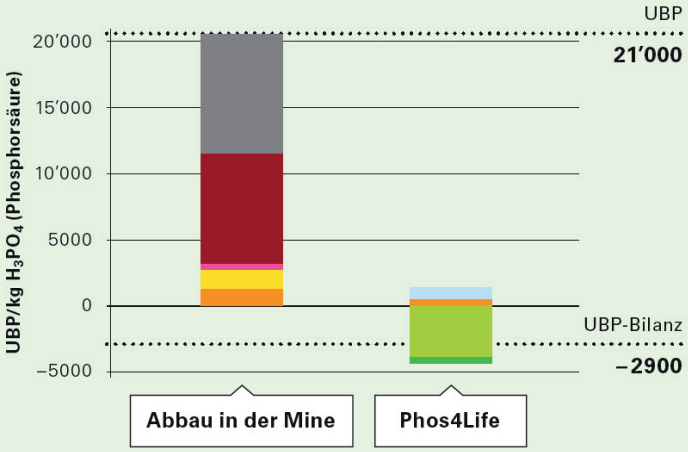
Results in detail

Phosphorus with a yield of over 95% could be extracted from sewage sludge ash and converted into technically pure phosphoric acid. Solvent extraction, the chosen "purification process" for phosphoric acid, proved to be efficient. After start-up of the plant, a consistently high product quality was achieved. The phosphoric acid obtained in this way is a globally established commercial product which, due to its high purity, can be used in a wide range of uses from fertilizer production to technical applications.

- Iron could be recovered with a yield of 75%; it is used as a precipitant for phosphorus elimination in sewage treatment plants. The product can be sold by the sewage treatment plants or through the chemical trade.
- The mineral content of the CRSA is free of heavy metals and therefore meets Swiss quality requirements for material recycling. The separated metals are recycled.
- Recycling from phosphorus is ecologically much more advantageous than mining from phosphate mines (see diagram, German only).

Phos4Life-Verfahren ist viel ökologischer als Abbau in der Mine

In der Ökobilanz generiert der Abbau in der Phosphatmine 21'000 Umweltbelastungspunkte (UBP) pro Kilo Phosphorsäure, während Phos4Life mit minus 2900 UPB die Umwelt schont.



Quelle: ETH Zürich (Mehr & Hellweg, 2018)

Feasibility study

For Switzerland to implement efficient processes for the mandatory recovery of phosphorus from wastewater by 2026, the possible solutions must be based on the current existing infrastructure. Operators of wastewater treat- ment and sewage sludge incineration plants initiated a dialogue with the concerned associations in Autumn 2017 to provide the basis for future process decisions. For this purpose, a «procedural market analysis for phosphorus recovery from wastewater » (VTMA) was carried out, the findings of which can be summarized as follows for owners of sewage sludge recycling plants (CRSA):

- Phosphoric acid as a recovery product is regarded as the preferred method,
- For domestic recycling, centralization and cooperation help to keep costs as low as possible,
- Preliminary projects are recommended to specify the implementation.

Synergies with the SwissZinc project at the Emmenspitz site

Both in the Phos4life® and SwissZinc processes, solvent extraction by the Spanish general contractor Técnicas Reunidas is the decisive process step.

The viability of synergies will be investigated with a preliminary project: Can the Phos4life process be integrated at the same site with other partners, i.e. the producers of approx. 30,000–40,000 tonnes of sewage sludge ash? Positive economies of scale through the simultaneous construction phase of the new KVA KEBAG Enova (2025), the SwissZinc plant (2023) and the possible implementation of Phos4life could thus be achieved.

By far the greatest synergies will be at the operational level. Common practices in operation management of the zinc and phosphorus recovery plant, quality management, process analysis, material procurement and management, shift operation and maintenance and repair work can be used advantageously.

In addition to the sufficient supply of steam and energy from the Municipal waste incineration plant (MWIP), the Emmenspitz site offers further advantages due to its central location, so that it makes sense to test the integrability of the Phos4life® process.

Target

Possible synergies are to be quantified and the economy of implementation determined. The operation should be cost-covering without any profit intention and guarantee an eco-efficient, sustainable and long-term safe recycling of the ash from sewage sludge. In addition to checking the technical and structural integration, the logistics are also checked for implementation and suitability for approval.

Scope of work

Within the scope of the engineering work to be carried out, the following important points are evaluated, among others, which enable a detailed assessment of the Phos4life® process:

- Process flow diagrams and mass balance
- Layout data and building model
- Determination of operating and capital costs (OPEX ±10%, CAPEX±30%)
- Logistics concept for management
- Identification and evaluation of synergy potentials
- Influence of site selection on economic efficiency
- Profitability and sensitivity analysis
- risk observation
- Clarifications under submission law

Project organization

The preliminary project is managed by the ZAR Foundation and coordinated by a steering group in which the sewage sludge owners involved are represented. Project management by the ZAR Foundation enables the direct award of the work to be carried out to the Spanish general contractor and technology owner Técnicas Reunidas S.A. (TR) based on the previous submission of work completed to date. TR is responsible for the execution of the core technology – the actual Phos4life process. Foundational work regarding approvability, determination of building and layout information, creation of a logistics concept, storage and provision of operating equipment, peripheral operations and EI&C data are developed by suitable engineering offices and integrated into the overall concept. The interfaces to the ongoing projects KEBAG Enova and SwissZinc are ensured by the partners involved.

(Sources: Building Directorate of the Canton of Zurich, AWEL Office for Waste, Water, Energy and Air, Project Sheet No. 6 and report on the preliminary project Phos4life®, Emmenspitz, Dr. Stefan Schlumberger)

Pilot plant at the site of Técnicas Reunidas S.A. in Madrid ►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B
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SWISSZINC-PROJECT

The preliminary project SwissZinc was successfully completed in April 2018. 28 out of 29 Swiss Municipal waste incineration plants (MWIP) have subsequently decided to implement the SwissZinc process in a national plant in Emmenspitz. The ZAR Foundation was significantly involved in this project.

Background

MWIP filter ashes contain metals that enter the exhaust gas stream during the incineration process. Among other materials, zinc is enriched in the filter ashes. It is possible to extract zinc and other metals such as lead, copper and cadmium from the filter ashes. For this purpose, these must first be treated with the so-called acid fly ash wash (FLUWA). This produces two fractions: a fraction removed from heavy metals (the washed ash) and a fraction rich in metals (the hydroxide sludge). According to the latest Swiss legislation, the Waste Ordinance for the Prevention and Disposal of Waste (VVEA), which came into force in 2016, MWIPs must apply state-of-the-art recovery of metals from their filter ashes by 2021.

To meet these VVEA requirements, the FLUWA process will be implemented throughout Switzerland by 2021. New FLUWA capacities are being built up in regional centers for the 44% of the Swiss fly ash volume not yet treated. The extracted metals are enriched in the hydroxide sludges and are currently being processed abroad. Alternatively, the SwissZinc project was launched to demonstrate the nationwide, industry-internal recoverability of metals from hydroxide sludges at the Emmenspitz site in analogy to the FLUREC process established there since 2013.

Technical feasibility proven

It could be shown that the recovery of zinc (Zn), lead (Pb), copper (Cu) and cadmium (Cd) from the hydroxide sludges is technically possible. Zn and Cd can be recovered from the hydroxide sludges with yields > 95%, Pb and Cu with yields > 80%. Zn is converted into “special high grade zinc” (>99.995% purity) and sold as a commercial product. The other metals are fed into further processing as a concentrate and recycled there.

Economics of the process

Based on the previously determined process engineering principles, the operating costs (OPEX) and investments (CAPEX) could be determined with an accuracy of OPEX±10% and CAPEX±30%, respectively.

Since zinc sales alone cannot cover the costs, the uncovered costs of CHF 5 million per year must be covered by a recycling fee. With a predicted hydroxide sludge volume of 27,000 t/a (30% dry matter content), the acceptance price is 185 CHF/t. The transport of the hydroxide sludge to the central plant at KEBAG Zuchwil site will be largely carried out in ACTS containers by rail in an environmentally friendly manner and organized by SwissZinc. The transport cost of hydroxide sludge based on the average costs for all FLUWA locations has calculated at 32 CHF/t. This results in a total cost of CHF 217 per tonne of hydroxide sludge (based on 30% dry weight).

If one compares this 217 CHF/t with today›s usual recycling costs of >250 CHF/t for export and subsequent zinc recovery using the rolling process and zinc smelting, SwissZinc recovery is more favorable for hydroxide sludges with 30% dry weight content. Even if the hydroxide sludge is dried to 70% DS content, the treatment costs are in a similar range.

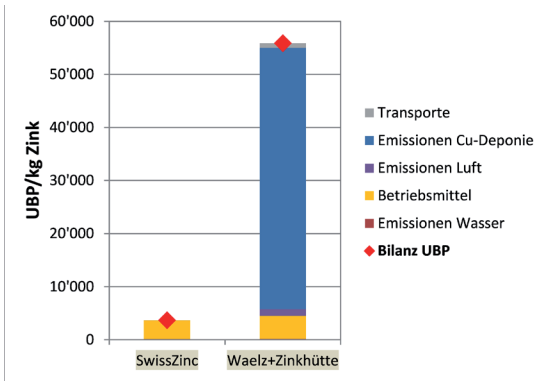
Ecological benchmarking

The SwissZinc process causes significantly less environmental pollution than the export of hydroxide sludges to the rolling process with subsequent zinc smelting, mainly practiced today. This is illustrated in the following figure as an example of the method of ecological scarcity (based in calculation of environmental impact points, UBP). SwissZinc closes material cycles, recovers metals, minimises transport and landfillingof heavy metal-removed residues in Switzerland and makes direct use of environmentally friendly MWIP energy.

Pioneering for the future

With the SwissZinc process, the material recycling of todays hazardous waste hydroxide sludge is legally compliant and based on state-of-the-art technology within Switzerland.

This results in a higher disposal security as well as minimal dependence on foreign countries - both legally and financially. Additionally the value added locally by the MWIP sector shows the effective recycling costs without any surcharges. Due to the transparent material flows, every operator can prove compliant recovery of the metals from the fly ashes without any problems.



▲Life cycle assessment comparison of the SwissZinc process with the export practiced today and subsequent recycling via the rolling process and zinc smelting (Source: ETH Zurich, M. Haupt and S. Hellweg, 2018)

SwissZinc – as an industry solution for efficient metal recovery from MWIP fly ashes and the resulting hydroxide sludges – makes it possible to combine forces to increase efficiency and make targeted use of synergies. In the long term, this represents the optimal implementation of VVEA requirements, both ecologically and economically.

Next steps

In the next stage, the ownership of SwissZinc AG will be transferred to the MWIPs from the previous sole shareholder - the Association of Swiss Waste Incineration Plant Operators (VBSA). Subsequently, a construction project will be carried out with the aim of increasing cost accuracy (CAPEX

±15%) – as well as preparing the permit documents. The planned construction of the plant is in Emmenspitz (SO)which is the location of the Zweckverband der Abwasserregion Solothurn-Emme (ZASE) and the KEBAG. After the final decision by the General Assembly and approval by the authorities, construction of the plant can begin. Commissioning is expected in mid 2023. The goal is to produce about 2,200 tons of high-purity zinc metal annually

(Source: Project sheet No. 3, SwissZinc, Dr. S. Schlumberger)

The mineral content of the dry bottom ash is currently separated into two quality grades during processing by ZAV Recycling AG and stored separately. Quality A consists of the processed fine bottom ash 0.2–3 mm (11%) and the coarse bottom ash 2–12 mm (36%), which is installed in a test section of the Chrüzlen landfill in Oetwil am See. From October 2016 to December 2017, a total of 47,000 tonnes of bottom ash A was deposited and the paving work is expected to be completed in spring 2019. Quality B, a mixture of bottom ash dust 0–0.3 mm (14%) and magnetic bottom ash 0.3–12 mm (39%), is deposited on bottom ash sections of other landfills. Despite various investigations into the use of the processed dry bottom ash as a building material, it is currently only possible to despose the bottom ash in landfills. The separated depositing of bottom ash A in the Chrüzlen test section is used to investigate the incorporation and sedimentation behavior of the dry bottom ash over time. The findings serve as a basis for future landfill projects with the goal of maintenance-free disposal of residues.

Landfill monitoring

The company (supplier) SWAN Analytische Instrumente AG, Hinwil installed an on-line measurement system for leachate monitoring in 2015. The continuous filling of the bottom ash test section led to an increased discharge of material via the leachate since 2017, which made constant operation of the measuring facility increasingly difficult. Two temperature sensors were installed in May 2017 to monitor the temperature development of the deposited dry bottom ash. The prevailing conditions in the landfill section (temperatures up to 80°C and strong alkaline pH values) led to corrosion after a few months and finally to complete sensor failure.

Based on this experience, a new landfill monitoring system will be installed by summer 2018 in cooperation with a new supplier, Meteotest AG, Berne. The aim is to create a hydrological model and a material balance of the landfill. The water balance of the landfill is investigated taking into account precipitation, evapotranspiration, water absorption of bottom ash and leachate discharge. The chemical analysis of the leachate and the landfill gas are included in the hydrological model for freight calculations. Monitoring of leachate and gas emissions and recording the temperature development in the landfill section are used for scaling laboratory tests. Alteration processes in bottom ashs and the fixation and mobilization of pollutants are investigated by means of laboratory testing. The data is used to develop scenarios for the long-term behavior of the dry bottom ash. The objective is to achieve a leachate which can be discharged into a surface water without treatment. The dry processed bottom ash is a product for which longer time data regarding landfill is not available. A comparison of the results of this study with long-term data of wet bottom ash discharged in landfills helps to close this gap and to estimate the hazard potential.

Ammonia emissions

When the bottom ash is loaded at ZAV Recycling AG, the typical ammonia smell results due to the addition of approx. 7% water. Tipping and circulation of the bottom ash during landfilling in combination with the interaction of meteoric water leads to strong ammonia production and odor emissions at the landfill site. Since March 2017, the installation of passive collectors has monitored the quantity and spread of gas emissions. In addition to the passive collectors, an Aircube with active ventilation for the electrochemical measurement of ammoniac will be installed in the center of the section as part of

the landfill monitoring from summer 2018. With this continuous measurement, conclusions can be drawn as to how the installation of bottom ash or the weather conditions affect ammoniac emissions.

The concept is supplemented by the logging of the landfill operator (times of installation) and the residents (times of odor nuisance).

Maintenance-free depositing

To achieve the goal of maintenance-free depositing of dry bottom ash, emissions from the bottom ash into the air and leachate must be reduced. The reduction of ammoniac emissions through targeted treatment of the material requires a deeper understanding of ammoniac formation, which is currently being developed in cooperation with the Institute of Geology in Berne and UMTEC in Rapperswil. The focus is on the identification of nitrogen sources in the different bottom ash fractions based on grain-size (nitrides, ammonium salts, etc.). The goal is to develop an understanding of the mechanisms of nitrogen transfer from solid to gas phase, considering surface effects, pH value, temperature and redox conditions. To achieve a sustainable reduction of dry-processed bottom ash emissions, the specific treatment of the individual fractions will be investigated and tested first in the laboratory and later on a large scale (soil washing plant KIBAG) by the end of 2018.

Landfill Chrüzlen ►

PUBLIC

Information event

Phosphor Conference
Wednesday, September 6, 2017, Zurich

Around 150 guests from Switzerland and neighboring countries who work in the fields of waste recycling, wastewater treatment and environmental and water protection accepted the invitation of AWEL and the ZAR Foundation to the Zurich event.

The participants were informed in detail about the project progress in phosphorus mining and the Phos4life® process with lectures and a subsequent panel discussion. Finally, a joint visit to the "Werdhölzli" sewage sludge recycling plant was on the agenda.

Magaldi Days

Participation in the "Magaldi WtE Open Day" at the waste incineration plant in San Vittore del Lazio (FR) in October provided a good opportunity to present the latest findings to an international audience and emphasize differences from other technological approaches.

Visitors

Since the foundation was established in 2010, it has been the concern of all participants to communicate the findings and achievements to a broad audience. This applies both to target groups operating in the same technical environment and information to the general public, in order to raise public awareness for sustainable consumer behavior and how to adapt where possible.

The number of visitors remained at a very high level in 2017.

Publications (in German only)

«Businessplan»: Phosphor-Mining im Kanton Zürich
February 2017, Dr. Stefan Schlumberger

Projektblatt Nr. 5 – Phosphor-Mining: Die Zielvorgaben lassen sich erfüllen.
April 2017, Co-Autor: Dr. Stefan Schlumberger

Statusbericht 2017 – Leistungsfähigkeit und Potentiale der Schlackenaufbereitungsanlage der ZAV Recycling AG
July 2017, Daniel Böni

Projektblatt Nr. 5 – Phosphor-Mining: Die Zielvorgaben lassen sich erfüllen.

Publiziert durch Baudirektion des Kantons Zürich, AWEL Amt für Abfall, Wasser, Energie und Luft
April 2017, Co-Autor Dr. Stefan Schlumberger

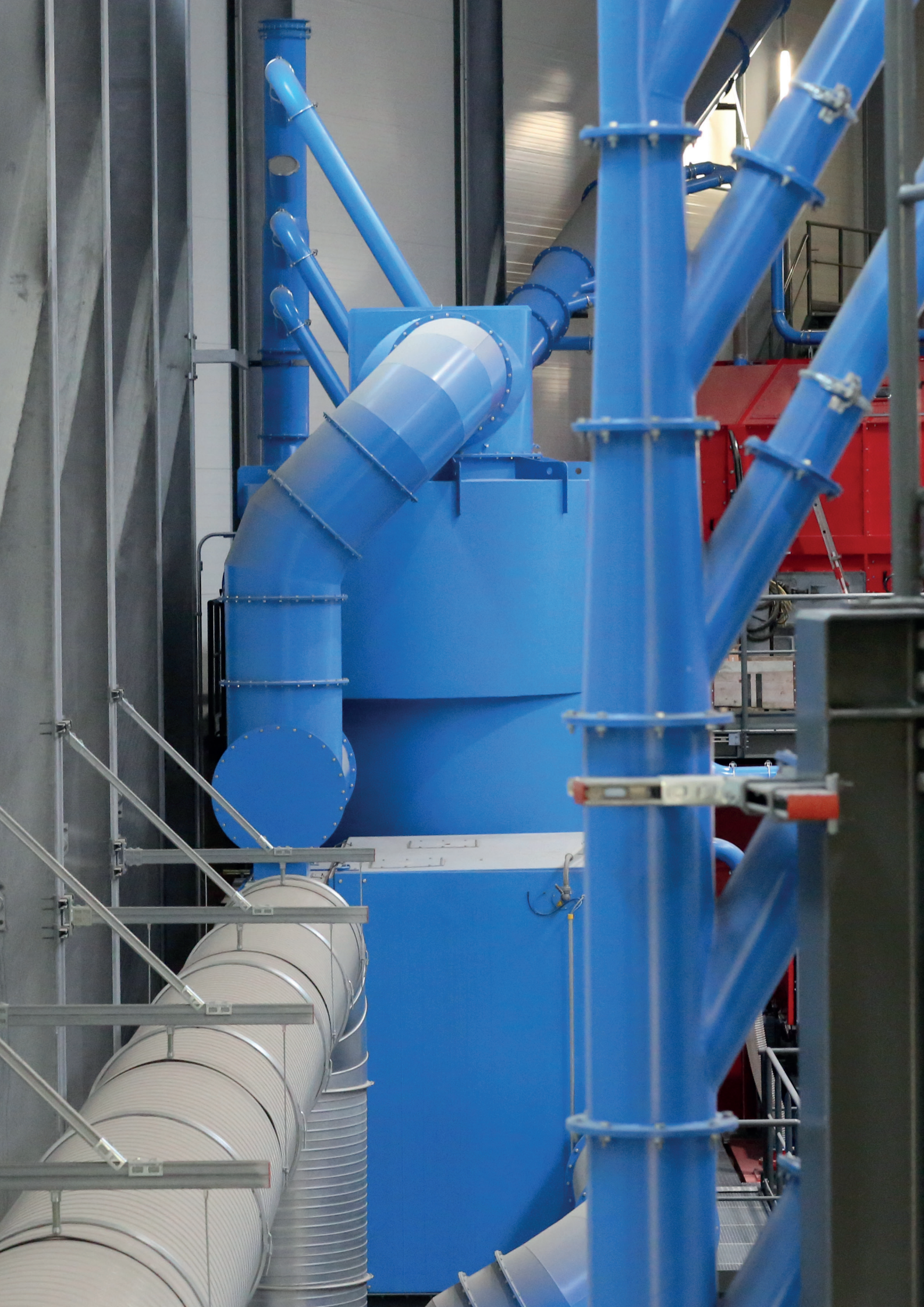
Faktenblatt zur verfahrenstechnischen Marktanalyse VTMA 2017/18
May 2017, Dr. Stefan Schlumberger

Zwischenbericht zum Projekt SwissZinc
April 2017, Dr. Stefan Schlumberger

Bericht zu den hydrometallurgischen Extraktionsversuchen mit Bohrkernmaterial der Chemie Uetikon AG
May 2017, Anna Zappatini and Dr. Stefan Schlumberger

Faktenblatt zur Aussprache des Baudirektors mit den politisch Verantwortlichen der Zürcher Kehrichtverwertungsanlagen zum Thema Verwertung und Deponierung der Kehrichtschlacke vom 27.11.2017
November 2017, Daniel Böni

Processing plant of ZAV Recycling AG ►



Foundation

EXCERPT FROM THE FOUNDATION CERTIFICATE

Art. 2 PURPOSE OF THE FOUNDATION

The purpose of the foundation is to promote a sustainable materials policy for the treatment and recycling of waste. It promotes the further development of state-of-the-art technology and supports the corresponding development activities which are to take place in the immediate vicinity of the waste-to-energy plant of the Zweckverband Kehrichtverwertung Zürcher Oberland KEZO in Hinwil/ZH or its legal successor. The foundation can also support the commercial exploitation of the findings.

With a broad Swiss sponsorship and cooperation with interested parties, it is intended to ensure that the knowledge gained is incorporated into plant development and plant construction in Switzerland or abroad.

The purpose of the foundation can be extended to activities with similar objectives at a later date.

We reserve the right to change the purpose of the foundation in accordance with Art. 86a ZGB (Swiss Civil Code). The foundation does not pursue any commercial purposes and is not profit-oriented.

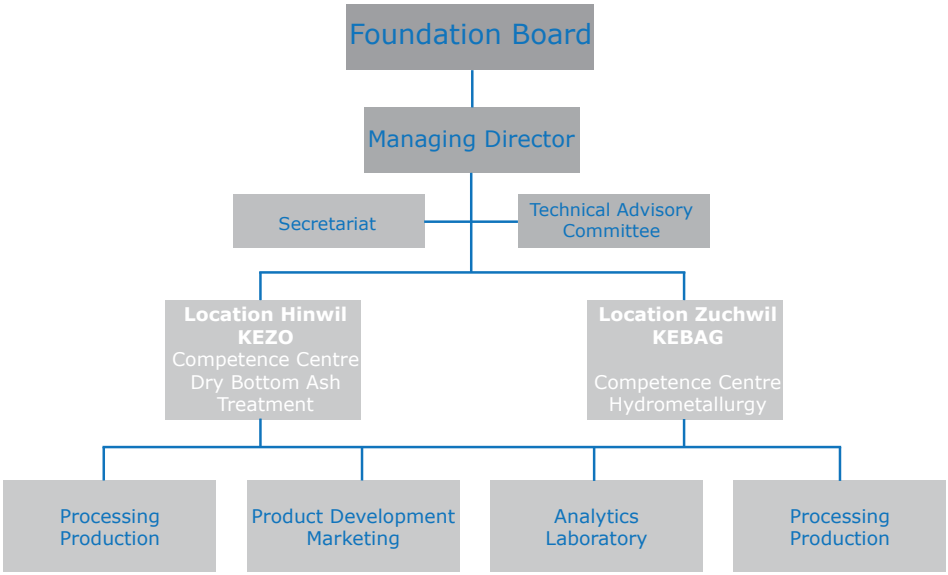
FOUNDERS

AWEL
Amt für Abfall, Wasser, Energie und Luft des Kantons Zürich
(Department for Waste, Water, Energy and Air of the Canton of Zurich)

VBSA
Verband der Betreiber Schweizerischer Abfallverwertungsanlagen
(Swiss Association of Waste-processing Plants)

KEZO
Zweckverband Kehrichtverwertung Zürcher Oberland, Hinwil
(Association of Waste Disposal for the Zurich Oberland, Hinwil)

ORGANIGRAM



FOUNDATION BOARD (AS OF 31.12.2017)

President

Dr. Büchi, Ueli, Chairman of the board, KEZO

Vice president

Dr. Fahrni, Hans-Peter, Senior Consultant

Board Member

Adam, Franz
Department Head, Department of Waste Management and Operations AWEL, Canton Zurich

Christen, Daniel
Managing Director, Foundation for Auto Recycling Switzerland SARS

Kalunder, Werner
HOLINGER AG, Director for the Suisse romande

Juchli, Markus
KEBAG AG, Director

Martin, Ulrich
MARTIN GmbH, Proprietor

Süsstrunk, René
Hitachi Zosen INOVA AG, Flue Gas Cleaning Plant Technology

TECNICAL ADVISORY COMMITEE

Dr. Morf, Leo (presidency)
Departement of Waste Management & Operations, Canton Zürich

Bolliger, Markus
Jura-Cement-AG, Wildegg

Prof. emer. Dr. Brunner , Paul H.
TU Wien

Dr. Gablinger, Helen
Hitachi Zosen INOVA AG, Zurich

Prof. Dr. Hellweg, Stefanie
ETH Zürich, Institute or Environmental Engineering, Zurich

Dr. Ing. Koralewska, Ralf
MARTIN GmbH, Munich

Dr. Kündig, Rainer
Swiss Geotechnical Commission, Zurich

Dr. Liechti, Jürg
Neosys AG, Gerlafingen

Dr. Zeltner, Christoph
Stahl Gerlafingen AG, Gerlafingen

ZAR-TEAM

Location KEZO, Hinwil

Böni, Daniel	Managing Director
Di Lorenzo, Fabian	Project manager – Metallic raw materials
Dr. Weibel, Gisela	Project manager – Mineral raw materials
Böni, Frauke	Secretariat

Location KEBAG, Zuchwil

Dr. Schlumberger, Stefan	Head of Hydrometallurgy Competence Center
Klink, Waldemar	Project Manager – Hydrometallurgy
Zappatini, Anna	Project Manager, Laboratory Manager

Donors 2017

In alphabetical order

ACR–Azienda cantonale di rifiuti	Giubiasco
BACHEMA AG	Schlieren
Bau-, Verkehrs- & Energiedirektion Kanton Bern BVE	Bern
BSH Umweltservice AG	Sursee
Direction générale de l'environnement DGE, Etat de Vaud	Lausanne
ERZ Entsorgung + Recycling Zürich	Zürich
EWB Energie Wasser Bern	Bern
Hitachi Zosen INOVA AG	Zürich
KEBAG AG	Zuchwil
KEZO Kehrichtverwertung Zürcher Oberland	Hinwil
KIBAG RE AG	Rotkreuz
KVA Linth	Niederurnen
Magaldi Industrie s.r.l.	Salerno (I)
MARTIN AG für Umwelt- und Energietechnik	Wettingen
Renergia Zentralschweiz AG	Perlen
SAIDEF	Fribourg
SATOM AG	Monthey
SITA Deutschland GmbH	Mannheim (D)
STAG AG	Maienfeld
Trumag Aufbereitungstechnik AG	Frutigen
Verband KVA Thurgau	Weinfelden
WIEDAG AG	Oetwil a.S.
Zweckverband für Abfallverwertung im Bezirk Horgen	Horgen

Financial Report

Income Statement

		2017 in CHF		2016 in CHF
Donations		721 745.00		737 000.00
Other Income		0.00		0.00
Subsidies AWEL		420 000.00		980 000.00
Support contributions BAFU		0.00		70 000.00
Service revenues		461 294.95		126 200.00
Erträge		**1 603 039.95**		**1 912 290.00**
Personnel expenditure		**677 981.65**		**1 912 290.00**
Third party services	558 698.89		727 325.05	
Social Security	118 296.78		178 276.00	
Other personnel expenses	733.61		0.00	
Training and further education Employee	252.37		214.52	
Remuneration from social security funds	0.00		-4 581.50	
Operating expenses		**1 003 082.02**		**971 916.23**
Material-costs	509.31		15 354.86	
Studies & analysis costs	34 606.01		11 803.98	
Expenses for third-party services	768 692.94		692 337.79	
Expenses SwissZinc AG	73 408.00		70 221.29	
Expenses KEZO	0.00		790.04	
Expenses ZAV Recycling AG	0.00		2 533.33	
KEBAG rental expenses	65 000.00		65 000.00	
Maintenance/Repairs	0.00		0.00	
Administration & IT-expenses	3 335.46		2 698.85	
Public relations	1 070.71		170.53	
Representation expenses	8 699.46		12 249.17	
Fee Board of Trustees	5 000.00		0.00	
Costs Foundation Board	5 205.09		15 000.00	
Costs Technical Advisory Board	32.00		0.00	
Other operating costs	6 412.10		5 967.45	
Value added tax from subsidies	31 110.94		77 788.94	
Operating income		**0.00**		**-3 320.37**
Income from offsetting costs from ZAV RE AG	0.00		-2 533.33	
Income from offsetting costs from KEZO	0.00		-787.04	
Operating result before depreciation and interest		**-78 023.72**		**-42 460.07**

		2017 in CHF		2016 in CHF
Depreciation		**34 023.52**		**63 656.15**
Valuation adjustments on Fixed Asset Items	34 023.52		63 656.15	
Earnings before interest and taxes		**-112 047.24**		**-21 196.08**
Cost reduction		**50 000.00**		**0.00**
Losses on accounts receivable	50 000.00		0.00	
Financial expenditure		**154.80**		**339.68**
Interest cost	0.00		219.00	
Other financial expenses	154.80		120.68	
Financial income		**0.50**		**-3 475.13**
Interest income	0.50		41.80	
Exchange rate gains (losses)	0.00		-3 516.93	
PROFIT/LOSS FOR THE YEAR		**-162 201.54**		**-25 010.89**

Balance Sheet

Assets	31.12.2017 in CHF	Change	31.12.2016 in CHF	Change
Cash and cash equivalents	**841 538.93**	76.2%	**962 508.09**	59.9%
Raiffeisenbank Uster, current account	841 352.48		959 322.14	
Raiffeisenbank Uster, investment account	186.45		3 185.95	
Trade accounts receivable	**147 592.11**	13.4%	**508 200.00**	31.7%
Receivables donor contributions	198 800.00		247 400.00	
Receivables subsidies/support contributions			250 000.00	
Receivables third parties	2 792.11		10 800.00	
Del credere	-54 000.00			
Other current receivables	**-**	0.0%	**13.55**	0.0%
Anticipation tax	-		13.55	
Inventories and unbilled services	**-**	0.0%	**-**	0.0%
Stocks	-		-	
Accrued income and prepaid expenses	**91 000.00**	8.2%	**77 213.00**	4.8%
Prepaid expenses TA	91 000.00		77 213.00	
Current assets	**1 080 131.04**	97.9%	**1 547 934.64**	96.4%
Financial assets	**-**		**-**	
Fixed installations	-		-	
Movable assets	**23 595.36**	2.1%	**57 618.88**	3.6%
iCAP 7600 ICP-OES Duo (analyzes equipment)	87 789.84		87 789.84	
Spectro Blue 138491	60 217.92		60 217.92	
Vibrating disk mill	22 109.83		22 109.83	
Value adjustments of tools and equipment	-146 522.23		-112 498.71	
Fixed assets	**23 595.36**	2.1%	**57 618.88**	3.6%
TOTAL ASSETS	**1 103 726.40**	100.0%	**1 605 553.52**	100.0%

Liabilities

	31.12.2017 in CHF	Change	31.12.2016 in CHF	Change
Trade accounts payable	**790 883.37**	71.7%	**1 213 184.07**	75.6%
Accounts payable to third parties	576 472.72		648 396.41	
Accounts payable KEZO	214 410.65		564 787.66	
Short-term interest-bearing liabilities	**3 762.98**	0.0%	**8 453.51**	0.5%
Value added / revenue taxes	3 762.98		8 453.51	
Deferred income	**98 085.40**	8.9%	**10 719.75**	0.7%
Accrued expenses and deferred income	98 085.40		10 719.75	
Short-term liabilities	**892 731.75**	80.9%	**1 232 357.33**	76.8%
Endowment capital	100 000		100 000	
RESERVES	273 196.19		298 207.08	
Project reserve	-162 201.54		-25 010.89	
Annual result	**210 994.65**	19.1%	**373 196.19**	23.2%
EQUITY CAPITAL	**1 103 726.40**	100.0%	**1 605 553.52**	100.0%
TOTAL LIABILITIES				

Notes to the financial statements

1. Information on the accounting principles applied in the annual financial statements

These financial statements have been prepared in accordance with the provisions of Swiss law, in particular the articles on commercial accounting and financial reporting under the Swiss Code of Obligations (Arts. 957 to 962).

2. Name, legal form and domicile of the foundation

ZAR, Development center for sustainable management of recyclable waste and resources, Zurich

c/o Building Directorate of the Canton of Zurich, AWEL, Office for Waste, Water, Energy and Air,

Walcheplatz 2, 8001 Zurich

Further address: c/o Zürcher Oberland KEZO, Wildbachstrasse 2, 8340 Hinwil, Switzerland

Auditors: PricewaterhouseCoopers (CH-320.9.045.078-2), in St. Gallen

3. Information egarding authorized signatories

President and Vice-President with joint signature of two:

Dr. Ulrich Büchi, von Maur, in Maur, Chairman of the Board of Trustees

Dr. Hans Peter Fahrni, von Steffisburg, in Boll, Vice Chairman of the Board of Trustees

Members of the Board of Trustees with joint signature of two:

Franz Adam, von Oberdorf SO, in Riedholz, Member of the Board of Trustees

Members of the Board of Trustees without signing authority:

Daniel Christen, from Kallern, in Port

Markus Juchli, from Zufikon, in Zuchwil

Werner Kalunder, from Wängi, in Vich

Ulrich Martin, German citizen, in Munich (DE)

René Süsstrunk, from Winterthur, in Wiesendangen

Further persons with joint signature of two:

Daniel Böni, from Amden, in Bülach, Managing Director

Yvonne Wicki, from Ruswil, in Zell ZH

4. Information, breakdown and explanations of balance sheet and income statement items

	31.12.2017	31.12.2016
Property, plant and equipment	170 117.59	170 117.59
Value adjustments	146 522.23	112 498.71

The assets were depreciated at 20% in line with the progress of the project.

5. Net release of hidden reserves

	31.12.2017	31.12.2016
Material net release of hidden reserves	none	none

6. Number of employees, external employee

	31.12.2017	31.12.2016
Number of full-time employees (annual average)	< 10	< 10

7. Shareholdings

None

8. Other information

	31.12.2017	31.12.2016
Off-balance sheet lease liabilities	0.00	0.00
Liabilities to pension funds	0.00	0.00
Total amount of collateral provided for third-party liabilities	0.00	0.00
Total amount used to secure own liabilities	0.00	0.00
Total amount of assets subject to retention of title	0.00	0.00

9. contingent liabilities

	31.12.2017	31.12.2016
Guarantees, warranties	0.00	0.00

10. Notes on items in the income statement

Subsidies: The AWEL will pay an additional subsidy of 60% of the eligible costs, up to a maximum of CHF 2 000 000, for the costs of phosphorus mining from sewage sludge ash. This subsidy is for the project «Production of phosphoric acid from sewage sludge ash» phase 2, deepening of the procedural principles. This is a restricted expenditure charged to the income statement. Subsidies of CHF 980 00 were paid for this phase 2 in 2016. A further phase was completed in 2017 and CHF 420 000 was reimbursed.

Third-party services: This item includes the following expenses:

	2017	2016
Tecnicas Reunidas,	0.00	
Process development for phosphorus separation from sewage sludge ash phase I	0.00	532 824.88
Tecnicas Reunidas, process development for the		
Phosphorus separation from sewage sludge ash phase II	737 743.91	88 668.33
ETH, SwissZink	0.00	30 000.00
Efficiency agency, eco-efficiency assessment	0.00	5 480.00
EAWAG: Expert opinion for salt loads in surface waters	0.00	15 972.22
Planning/Development of melting plant	23 625.02	0.00
Advice on patent rights	800.00	2 060.02
Various expert opinions	950.00	11 639.80
Landfill Monitoring	0.00	1 470.00
Various other services	5 574.01	4 222.54
Total third-party services	**768 692.94**	**692 337.79**

Other administrative expenses

	2017	2016
Fees to auditors	2 580.00	0.00
Miscellaneous consumables	225.46	965.00
Costs of supervision of foundations	530.00	537.00
thermo-re® brand registration	0.00	1196.85
Total other administrative expenses	**3 335.46**	**2 698.85**

11. Notes on extraordinary, non-recurring or off-period items in the income statement

None

12. Liabilities to pension funds

None

13. Significant events after the balance sheet date

There were no significant events between the balance sheet date and the approval of the annual financial statements by the Board of Trustees which could impair the informative value of the 2017 annual financial statements or which would have to be disclosed here.

Bericht der Revisionsstelle

zur eingeschränkten Revision an den Stiftungsrat der Stiftung Zentrum für nachhaltige Abfall- und Ressorcennutzung

Zürich

Als Revisionsstelle haben wir die Jahresrechnung (Bilanz, Erfolgsrechnung und Anhang) der Stiftung Zentrum für nachhaltige Abfall- und Ressorcennutzung für das am 31. Dezember 2017 abgeschlossene Geschäftsjahr geprüft.

Für die Jahresrechnung ist der Stiftungsrat verantwortlich, während unsere Aufgabe darin besteht, die Jahresrechnung zu prüfen. Wir bestätigen, dass wir die gesetzlichen Anforderungen hinsichtlich Zulassung und Unabhängigkeit erfüllen.

Unsere Revision erfolgte nach dem Schweizer Standard zur eingeschränkten Revision. Danach ist diese Revision so zu planen und durchzuführen, dass wesentliche Fehlaussagen in der Jahresrechnung erkannt werden. Eine eingeschränkte Revision umfasst hauptsächlich Befragungen und analytische Prüfungshandlungen sowie den Umständen angemessene Detailprüfungen der bei der geprüften Stiftung vorhandenen Unterlagen. Dagegen sind Prüfungen der betrieblichen Abläufe und des internen Kontrollsystems sowie Befragungen und weitere Prüfungshandlungen zur Aufdeckung deliktischer Handlungen oder anderer Gesetzesverstösse nicht Bestandteil dieser Revision.

Bei unserer Revision sind wir nicht auf Sachverhalte gestossen, aus denen wir schliessen müssten, dass die Jahresrechnung nicht dem Gesetz und der Stiftungsurkunde entspricht.

PricewaterhouseCoopers AG

Marcel Aeberhard	Fabian Schläpfer
Revisionsexperte Leitender Revisor	Revisionsexperte

Zürich, 6. April 2018

Beilage:

- Jahresrechnung (Bilanz, Erfolgsrechnung und Anhang)

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