STIFTUNG ZENTRUM FÜR NACHHALTIGE
ABFALL- UND RESSOURCENNUTZUNG

FOUNDATION DEVELOPMENT CENTER FOR SUSTAINABLE MANAGEMENT OF RECYCLABLE WASTE AND RESOURCES

Waste and Resource Management
Innovative, Practical, Economic

Annual Report 2013

Contents

Foreword by the President

Extensive development activities

The business report 2013 in hand looks back on the foundation‘s fourth successful year of operation. It is time to ask ourselves whether the foundation is still in alignment with its purpose. Generally speaking, foundations are usually able to persist a little longer than corporations in a competitive environment; however, a closer look will serve to provide certainty.

A review of article 2 of our charter confirms that we are still on track with the «promotion and further development of the state of the art», a fact we can proudly demonstrate. The processing of dry bottom ash in the immediate vicinity of the waste incineration power plant owned by the waste recycling association KEZO in Hinwil is also in full compliance with the foundation‘s articles of association.

However, we have also created a supporting leg by expanding our development activities in the wet chemicals sector in Zuchwil (canton Solothurn) in close cooperation with waste disposal company KEBAG Kehrichtbeseitigungs-AG. Although the ambassador city of Solothurn is not actually located in the «immediate vicinity» of the KEZO plant in Hinwil as required by our charter, the overall strategy behind our development activities is nonetheless implemented by the foundation‘s council in Zurich‘s Oberland region with the support of the board of technical advisors. As neither concepts nor know-how are location-dependent, the foundation‘s council was well within its rights to collaborate with KEBAG.

Our recently initiated cooperation with KEBAG proves once again that the ZAR foundation is not simply improving ecologically expedient abilities in a limited field of activity, but is rather operating within broadly defined system boundaries. This is the sole reason it has been possible to achieve major developmental progress in cooperation with industry, research, development and the authorities.

I would therefore like to express my thanks to all involved: the employees of the foundation and KEZO; our donors; the members of the foundation‘s council and technical advisory boards and the supporting authorities.

Dr. Ueli Büchi
President of the Foundation Board

Activity Report 2013

Residue from waste recycling – raw materials of the future

The wide range of very different tasks handled by the ZAR team during the course of 2013 shows once again how complex and ambitious our goal of closing the cycle of materials actually is. The activity report in hand contains a brief overview of the current status.

Dry bottom ash of the 3rd generation

Incinerator line number 2 at the waste-to-energy (WTE) association of the Zurich Oberland region (KEZO) was converted to dry bottom ash discharge (1st generation) in 2007. Following a two-year period of operating experience, the extraction of dry bottom ash from the incinerator line was completely redesigned and restructured (2nd generation). Dry bottom ash discharge of the 2nd generation went into operation on the 3rd incinerator line at KEZO in 2010. The third incinerator line at the KEZO plant is going to be converted to dry bottom ash discharge when bottom ash processing is commissioned by ZAV Recycling AG at the KEZO plant. The decision to develop the 3rd generation of bottom ash discharge for incinerator line 1 at KEZO in cooperation with the STAG Company of Maienfeld was based not only on six years of operating experience but also on changed basic conditions. The following goals were specified:

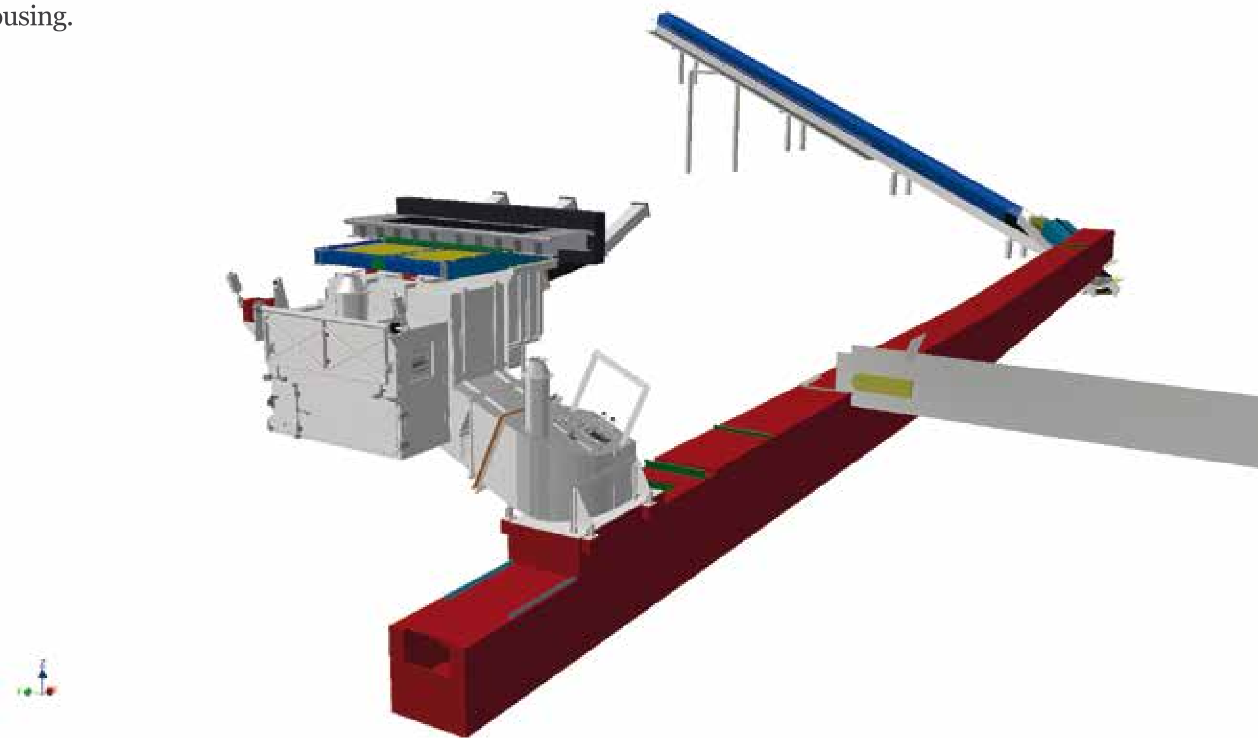
- No separation of the fine fraction in dry bottom ash
- Easier separation of the coarse fraction
- Easier emergency extraction
- Post-combustion possible without tertiary air in the incinerator
- Lower cost of maintenance
- Lower energy consumption

The excellent operating experience gained with the metal plate conveyor made by Magaldi S.r.l. of Salerno (IT) played a decisive role in the development of the 3rd generation. For the past two years the bottom ash extracted from incinerator lines 2 and 3 has been transported to the collection conveyor for all incinerator lines by the metal plate conveyor made by the company Magaldi. The experience gained over these two years shows maximum availability combined with minimum maintenance costs. Trials to test the transportation of all extracted ash, i.e. including ash with a grain size of less than 5 mm, with the metal plate conveyor produced positive results. These results led to the decision to replace the vibratory guttering as used in incinerator lines 2 and 3 with a metal plate conveyor. Additional reasons that spoke in favor of the decision were a low electricity consumption rate of around 0.2 kWh, a high thermal loading capacity, the absence of compensators and the lack of pulse waves.

The figure below shows how the dry bottom ash is fed directly onto the metal plate conveyor via a chute. The flow of dry bottom ash through the chute had to be rotated by 180° due to very tight spatial conditions. A prototype was used to analyze the sliding characteristics of dry bottom ash and various metal components, and a tailor-made solution was developed based on the results.

Coarse grain components are separated by a grizzly screen and filled into a closed container with fill level control and camera monitoring. Grizzly screens are used as primary separators for the preliminary separation of very large lumps of material broken down by jaw crushers. The closed container can also be used for emergency extraction. The local exhaust ventilation for wet bottom ash discharge is used to extract the air required for post-combustion and for cooling the bottom ash on the metal plate conveyor via the chute, and to return it to the incinerator as controlled, pre-heated secondary air. The installation enables detailed examination of the advantages and disadvantages of tertiary air in the same incinerator line.

The extraction system is designed to allow the discharge of rust through a double dump valve directly into the dry bottom ash as a second step after bottom ash discharge has started. The double dump flap is a simplified form of a lock with positively controlled flaps arranged vertically in a conveyor housing.



Non-ferrous separators of the 3rd generation

With regard to the future large-scale treatment plants for dry bottom ash, an ambitious goal of improving already very efficient NF separators by SGM Gantry SpA of Manerbio (IT) was defined in cooperation with SGM Gantry. This was the kick-off for developing the 3rd generation of the NF separators used by ZAR for fractions of 0.1–8.0 mm. The weak point analysis of the existing systems carried out by the ZAR team influenced the requirement specifications for the development engineers at SGM Gantry SpA.

Specifications included the following optimizations:

- Extend working width from 0.5 to 1 m
- No surface being prone to collect dust
- All dust generated in the machine must be removed together with the mineral content
- Lower motor speed of the magnetic drum with same effectiveness of NF extraction
- Vibration-free operation across the specified motor speed range
- Repositioning of the splitter plate
- Optimization of transport conveyor route in view of a longer operating life of the conveyors

Modifications to the existing systems were tested and improved where necessary on the basis of different prototypes and countless trials. The root causes of vibrations were detected by means of high resolution vibration measurements and analyses. SGM decided to completely redesign the rapidly rotating pole wheels to resolve the vibration problem once and for all. Thanks to persistent attention to the details, the NF separator of the 3rd generation now has a slightly better degree of efficiency and a much longer durability.

Eight of these NF separators have already been built for ZAV Recycling AG and have successfully passed the acceptance testing.

Large-scale treatment plant for dry bottom ash

The basic engineering for the bottom dry ash treamtment plant for ZAV Recycling AG was completed in 2012 under the guidance of the ZAR team and was followed in 2013 by detailed engineering for the large-scale plant. The use of significant ZAR resources is justified by the importance of this project with regard to the breakthrough in thermo-recycling. Many plant operators who are very enthusiastic about thermo-recycling have currently put investment plans on hold until this large-scale plant provides proof of success.

Each step in the process has been redesigned on the basis of the basic engineering specifications in cooperation with the company STAG AG of Maienfeld. The following criteria were optimized for each plant and for each step in the process:

- Material flow
- Operating scenarios for changing grain size distribution in the dry bottom ash
- Dust creation/extraction
- Noise emissions
- Emergency scenarios – in case of breakdown of individual process steps
- End product quality (iron, aluminum, stainless steel, NF precious metal fraction and slag)
- Accessibility/maintenance
- Energy consumption
- Standardization (spare parts)

Many plant inspections and intensive discussions with the operating engineers at various plants and with suppliers reduced the number of potential suppliers to just a few.

Dust-proof conveyor belt

The fact that some plant components had to be developed customer-specifically required building and testing prototypes for key plants. One such example is a 14 m long prototype of a dust-proof conveyor belt with an integrated scraper floor developed and manufactured by Trumag AG of Frutigen.
The conveyor belt was tested and optimized during continuous operation. The prototype also served to establish the maximum possible transport incline for dry bottom ash and large metal components to guarantee the best possible transport of materials in the plant.

Dust extraction

Extracting the dust from the sprawling plant is another significant technical challenge. Dust extraction is based on creating a minimum amount of negative pressure in the plant using as little energy as possible to extract as little dust as necessary. Designing the supply air system was a key measure alongside the extraction system itself, the position of the extractor and the concept for exhaust air conduction. To this end, ZAR employees Peter Schellenberg and Albino Miràs developed a very simple but highly effective system that maintains a constant air supply in function of the negative pressure, i.e. the negative pressure is kept constant by means of supply air regulation. The system was installed in the KEZO treatment plant in the summer with the result that dust formation due to extraction is now virtually completely eliminated.

The variety of tailor-made approaches is justified by the fact that the KEZO and ZAR team had no access to long-term experience and that up to now most suppliers have not been unable to come up with good solutions.

Once detail engineering was completed the ZAR team set to work establishing the basis for processing dry bottom ash components measuring 0.2–600 mm with the support of STAG AG. Having supervised construction, commissioning and optimization measures for the dry bottom ash processing plant operated by ZAV Recycling AG, the ZAR team was able to finalize a significant part in the development of the thermo-recycling process.

Bottom ash processing – State of the art

The «state of the art of bottom ash processing» developed at ZAR was determined for the first time and compared to wet ash processing. Two very different bottom ash processing plants were selected for a large-scale trial carried out by Wiedag AG of Oetwil am See at the Chrüzeln waste disposal site and a large-scale trial at KEZO that took place over the course of the same week. The results were evaluated on the basis of the AWEL draft «Establishing and describing the state of the art of bottom ash processing». The ZAR team's efforts to establish the state of the art were supported by Bachema AG of Schlieren and AWEL, canton Zurich's authority for waste, water, energy and air.

It proved expedient to describe the state of the art on the basis of the following three characteristics:

- Yield of the metals iron, aluminum and copper as the most common ones in dry bottom ash.
- Contamination of the mineral fraction in dry bottom ash (metallic residue) with copper and aluminum as ecologically significant metals.
- Specific energy requirements for processing dry bottom ash.

These criteria were checked on dry bottom ash grain sizes down to 0.1 mm. It was established that the evaluation effort increased disproportionally for grain sizes of less than 1.0 mm and that the error tolerance increased in the range below 1.0 mm. As the analyses for describing the state of the art had to be practical and the costs reasonable, it was decided to apply the specified criteria to grain sizes larger than 1.0 mm. A direct comparison of the quality of fine fraction processing (Wiedag: 1.0–8.0 mm, KEZO: 1.0–5.0 mm) revealed the large and significant differences in processing wet and dry bottom ash.

The following provisional state of the art for bottom ash processing was determined on the basis of the values established by KEZO and the fact that processing fines tends to be more difficult; this is still to be verified using the bottom ash processing plant at ZAV Recycling AG.

Evaluation

Yield
[kg of recyclable metal per kg of metal in the material]

Fe (metallic)	> 98 %
Al (metallic)	> 95 %
Cu (metallic)	> 90 %

Contamination of bottom ash residue: metallic NF metals
[mg NF metals per kg of bottom ash residue]

Al (metallic)	< 400 mg/kg
Cu (metallic)	< 350 mg/kg

Specific energy consumption across the entire process
[kWh per metric ton of processed bottom ash]

Quantity	< 20 kWh/t

RESH trials

Residue from shredding plants (RESH) is a special waste containing around 5 % of very fine-grain metals. Today, RESH produced in shredding plants in Switzerland is thermally recycled. The recovery of very fine metal components from conventional waste-to-energy plants (WTE) with wet bottom ash discharge is inadequate. WTE plants with dry bottom ash discharge, such as the KEZO plant in Hinwil, are very efficient at separating even the smallest metal components and returning them to the material cycle.

Initial position

In the past it has often been assumed that the high gold content of the NF precious metal fractions (0. 2–5.0 mm) reclaimed from the dry bottom ash at the KEZO plant did not originate from municipal waste but rather from the larger quantities of RESH incinerated at the KEZO plant.

The gold content of a fraction can only be determined with some degree of reliability if the gold is available in an enriched state. This is not the case with unprocessed dry bottom ash, which is the reason why the gold content of the ash cannot be reliably determined. It is, however, possible to determine the content in the NF precious metal fraction produced at KEZO, in which gold is present in concentrations of 100 g–300 g per tonne.

Hypothesis

The fact that none or only little gold is found in the NF precious metal fractions of other plants is primarily due to the respective thermo-recycling process and less to the composition of the waste.

Large-scale trial

The trials were intended to determine the influence of RESH on the incineration process and the subsequent processing of fines.

Trial design

- **Part 1:** RESH feed to both incinerator lines with downstream dry bottom ash discharge is stopped.
  Duration: 48 hours.
- **Part 2:** Start of sampling and measurement sequences without RESH. Ascertainment, calculation and sampling of the entire quantity of fine bottom ash particles smaller than 5 mm.
  Duration: 5 days.

- **Part 3:** Incinerator lines charged with 10% RESH.
  Duration: 48 hours.
- **Part 4:** Start of sampling and measurement sequences with RESH. Ascertainment, calculation and sampling of the entire quantity of fine bottom ash particles smaller than 5 mm.
  Duration: 5 days.

The addition of RESH did not change the absolute quantity of NF metals separated from the fines. The NF metal content without RESH was 2.6 %. The incineration of RESH slightly reduced the proportion of fines; this corresponds with a slightly higher metal content of 3.1% when there is no change in the metallic quantity. These small differences in the quantity of NF metals and in the concentrations of specific elements are due to the inhomogeneity of the incinerated waste. The high metal content of RESH and the assumption that these metals exist in the form of very fine particles should lead to a significant increase in both the amount of fines and the concentration of metals. As this is not the case, a large proportion of fines and their metals are extracted from RESH in the form of chunks together with the coarse grain material. Coarse grain material was not taken into account during these trials.

Conclusion

The trials have shown that the complex processes taking place inside the incinerator can only be analyzed precisely if all of the grain material is taken into account. The entire spectrum of dry bottom ash needs to be analyzed to establish the influence of RESH on the metal content in the ash. Filter bags and additional elements in exhaust gases should also be taken into consideration when calculating the quantities of metals and hazardous substances once dry bottom ash processing has started at ZAV Recycling AG.

However, this trial was able to demonstrate that the high gold content in the NF precious metal fraction is not influenced by the addition of RESH to the incineration material. We therefore assume that the metal content potential of RESH cannot be exploited until the large plant at ZAV Recycling AG is fully operational.

Minerals

Despite the efficient separation of metals from the dry bottom ash, the quality of the latter still fails to meet the requirements for disposal with no need for post-closure care. With a mass fraction of 85%, bottom ash residue still represents the main proportion of residue matter after thermal recycling. However, before specific processes can be developed to return the mineral fraction in the dry bottom ash to the cycle of materials, it is essential for ZAR to extend its basic knowledge of this bottom ash fraction.

Characterization of fines

Daily samples were extracted from processed dry bottom ash in the grain size ranges 0.2–1.0 mm and 1.0–5.0 mm over a five-month period. An analysis method for processed dry bottom ash was adapted in cooperation with the Swiss Federal Institute of Technology ETH Zurich in parallel. Based on this large number of analyses the following statements can be made:

The material compositions in the two examined fractions fluctuate across a small range.

- Heavy metals (Zn, Cu) are concentrated in the fines (0.2–1.0 mm).
- The heavy metal contamination in the fines (1.0–5.0 mm) decreases as the grain size increases.
- The sub-fraction of fines (4.5–5.0 mm) shows the lowest levels of heavy metals, although the overall content of Cu and Zn do not permit disposal at an inert waste site. This fraction also displays the lowest solubility.

On the basis of these insights ZAR will concentrate on the wet chemical extraction of metals from very fine bottom ash and the inertization of the mineral fraction in coarse bottom ash content.

Bottom ash as a raw material

Although bottom ash processing is very efficient, the residual aluminum content in the mineral fraction prevents its use as a cement substitute. Aluminum reacts with water in cement to produce gaseous hydrogen, which then forms small bubbles.

Bubble formation is generally undesirable unless the intended end product is a light-weight or foamy concrete. Trials have shown that washing the dry bottom ash content intensively leads to full oxidation, which eliminates the production of hydrogen in the cement mixture. Unfortunately, this method also resulted in a significant loss of rigidity in the cement sample.

As the increase in volume is virtually exclusively the result of gas formation, the decision was made to investigate the formation of gas from dry bottom ash in greater detail and in cooperation with the Rapperswil Institute for Environmental and Process Technology (UMTEC). The question as to whether other matrix elements or the compounds they form with aluminum contribute to gas formation will be clarified in detail in 2014.

Mineral fraaction of sludge ash

The separation of phosphor from sludge ash results in a mineral fraction which is contaminated with heavy metals. The aim of the investigations carried out in cooperation with UMTEC was to see whether an inert component could be separated from the fraction by means of a mechanical separation process. Despite applying many different mechanical separation methods it was not possible to separate inert material.

Again, we came to the conclusion that the wet chemical process is the perferred way ahead with regard to inertization of very fine material. Moreover, the trials also showed that inertized sludge ash in the form of a reddish-brown powder can be used as a raw material in the pigment and brick production industries.

Visitors

The general interest in the ZAR foundation and dry bottom ash processing was again significant this year. We had an opportunity to present our latest developments to the boards of the Swiss Environmental Authority (BAFU) and Germany’s authority for the environment as well as to numerous plant operators from Switzerland, Germany, France, Italy, Sweden, the USA and Saudi Arabia. We forged many new contacts in the process that will be of importance to the global propagation of thermo-recycling.

Wet chemical extraction

The foundation ZAR has to date successfully focussed on the pure physical-mechanical separation of metallic compounds to form concentrates and return them to the cycle of materials. However, the process is becoming increasingly more difficult as the particles are becoming smaller and is already reaching the limits of physical-mechanical feasibility with regard to very fine fractions and sludge ash. These findings led to the expansion of ZAR's competencies in the field of wet chemical extraction in September 2013; it is the ideal precondition to investigate the wet chemical options of reclaiming metals and inertizing potential fine-grain ash fractions in detail over the coming years.

Starting with the very fine fraction (< 0.25mm), wet chemical extraction trials with mineral acids (hydrochloric and sulfuric acid), trials with complexing acids and lyes will be carried over the coming months. In addition to the choice of extracting agents it is also possible to work towards the targeted depletion and recovery of relevant substances by changing temperature, concentration, pressure and dwell time. ZAR's own work in the field is accompanied by partnering universities to help better investigate and interpret the specific issues of the complex processes.

Phosphor as a resource and the recovery of metals are main focal points. Current efforts are focusing on improving the phosphor recovery process and on potential synergies with regard to wet chemical metal recovery. They are intended to support the decision-making process in the canton of Zurich with regard to a possible technical implementation.

The insights gained from wet chemical processing of filter ash, sludge and fines show that combined processing creates synergies. This demonstrates once again that the choice of system boundaries is crucial for the success of a technique or method.

Milestones

2005	Initial trials with dry bottom ash discharge on furnace line 2 at the KEZO incineration plant.
2006	Long-term trials with dry bottom ash discharge on furnace line 2 with ram bottom ash extractor and screening machine.
2007	Conversion of furnace line 2 to dry bottom ash discharge.
2008	Fine bottom ash treatment plant taken into operation.
2009	Optimization of dry bottom ash discharge on furnace line 2.
2010	The foundation «Development centre for sustainable management of recyclable waste and resources ZAR» is established. Dry bottom ash discharge taken into operation on furnace line 3. Creation of the thermo-re® brand.
2011	Optimization of Eddy Current Separator. Specification of the Ultra-Fine Bottom Ash treatment. Optimization of screening in continuous operation mode. Finalization of product development.
2012	Start-up of ultra-fine bottom-ash treatment plant (0.2–1.0 mm). Non-ferrous processing taken into operation (0.2–1.0 mm). Substitution of Eddy current separator first generation for a high performance separator (2nd generation by SGM Gantry (1.0–5.0 m). Evaluation and description of analyzing method for the non-ferrous fraction. Completion of basic engineering for the new large-scale plant of ZAV Recycling AG.

2013

March

Bottom ash processing: establishing the state of the art

Large-scale trials at Wiedag AG of Oetwil am See at the Chrüzeln waste disposal site and at KEZO, supported by AWEL and Bachema AG. The separating stage was determined at 1.0 mm.

The results were the specification for the yield of the most common metals by quantity (Fe, Al and Cu), the contamination of the mineral fraction in the bottom ash (metallic residue) with Cu and Al and the specific energy required for dry bottom ash processing.

April

The origin of gold in the NF fraction

Large-scale trial to determine, whether the origin of gold in dry bottom ash is a function of RESH content in the composition of incinerated waste.

The trial demonstrated that the high gold content in the NF precious metal fraction is not influenced by the addition of RESH to the incineration material. It is assumed that the metal content potential of RESH will be exploited after the large plant at ZAV Recycling AG has become operational.

May

Start of detail engineering

Optimization of individual process steps with regard to material flow, continuous operation, emissions, maintenance, energy, etc. Intensive exchange with potential suppliers; development, testing and prototype optimization.

July

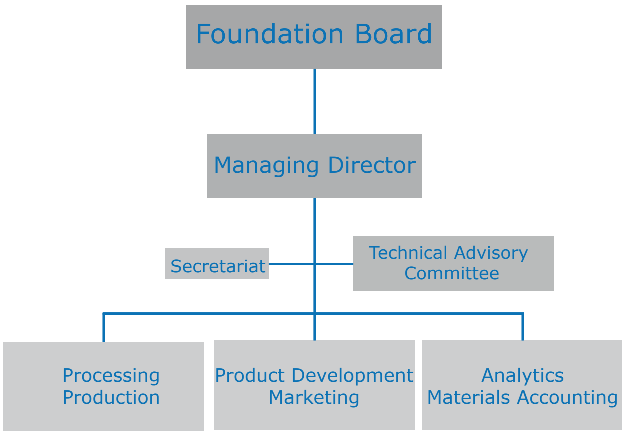
Eddy current separator of the 3rd generation

Start of development of an NF separator for 0.1–8.0 mm fractions by the company SGM Gantry SpA. Optimizations focus on a high degree of dust prevention, high efficiency, low vibrations and a long service life.

Wet chemical processing

Contractual agreement with the waste disposal company KEBAG Kehrichtbeseitigungs-AG, Zuchwil to expand competencies in the wet chemicals field. KEBAG provides the infrastructure and ZAR assumes personnel responsibility for two experts.

Organization



Foundation Board (as of 31.12.2013)

The foundation board is the highest decision making body of ZAR. It currently consists of nine members comprising representatives from the waste management industry, the base materials industry, the recycling industry and from environmental authorities. The foundation board represents ZAR in strategic, conceptional and financial issues. The foundation board convenes at least twice a year and decides on the budget and the annual program.

Presidency

Dr. Büchi, Ueli, President of the KEZO supervisory board

Vice Presidency

Dr. Fahrni, Hans-Peter, Senior Consultant

Board Member

Adam, Franz
Departement head of waste management & operations, AWEL, Canton ZH

Buttet, Yannick
Member of the national council, president of VBSA

Süsstrunk, René
Hitachi Zosen INOVA AG, flue gas treatment system

Christen, Daniel
Managing director of SARS Swiss Automobile Recycling Foundation

Dr. Hediger, Robert
Managing director of Fair Recycling Foundation

Kalunder, Werner
Director of HOLINGER AG, Western Switzerland

Martin, Johannes J. E
Managing director of MARTIN GmbH

Technical Advisory Commitee

The Technical Advisory Committee supports the managing director in the pursuit of the foundation's objectives. It consists of members who have a high degree of expert knowledge and complement the competencies of the managing director.

Dr. Morf, Leo (presidency)
Department for Waste Management & Operations, Canton Zurich

Prof. Dr. Brunner, Paul
TU Wien, Institute for Water Quality,
Resource Management and Waste Management, Vienna

Prof. Dr. Hellweg, Stefanie
ETH Zurich, Institute for Environmental Engineering, Zurich

Dr. Johnson, Annette
Eawag, Water Resources and Potable Water, Dübendorf

Dr.-Ing. Koralewska, Rolf
Martin GmbH, München

Dr. Kündig, Rainer
Swiss Geotechnical Commission, Zurich

Dr. Liechti, Jürg
Neosys AG, Gerlafingen

Sigg, Alfred
Hitachi Zosen INOVA AG, Zurich

Dr. Schlumberger, Stefan
BSH Umweltservice AG, Sursee

Streuli, Adrian
Jura-Cement-AG, Wildegg

Dr. Zeltner, Christoph
Stahl Gerlafingen AG, Gerlafingen

Operations

Böni, Daniel	Managing Director
Di Lorenzo, Fabian	Project Manager – Metallic raw materials
Dr. Ardia Paola	Project Manager – Mineral raw materials
Miràs Albino	Process development and production
Schellenberg, Peter	Process development and production
Bruno, Francesca	Secretariat

Founders

AWEL
Amt für Abfall, Wasser, Energie und Luft des Kantons Zürich
(The Cantonal Department of Waste, Water, Energy and Clean Air of Zurich)

VBSA
Verband der Betreiber Schweizerischer Abfallverwertungsanlagen
(Association of operators of Swiss waste recovery plants, Berne)

KEZO
Zweckverband Kehrichtverwertung Zürcher Oberland, Hinwil
(Consortium waste recovery for region Zurcher Oberland, Hinwil)

Donors 2013

In alphabetical order

Acr–Azienda cantonale di rifuiti	Giubiasco
AFATEK A/S	Kopenhagen (DK)
BACHEMA AG	Schlieren
Deponie Leigrueb AG	Lufingen
Stadt Zürich, ERZ Entsorgung + Recycling Zürich	Zürich
Hitachi Zosen INOVA AG	Zürich
KEZO Kehrichtverwertung Zürcher Oberland	Hinwil
LIMECO	Dietikon
Magaldi Industrie s.r.l.	Salerno (I)
MARTIN AG für Umwelt- und Energietechnik	Wettingen
Renergia Zentralschweiz AG	Perlen
SATOM AG	Monthey
SITA Deutschland GmbH	Mannheim (D)
STAG AG	Maienfeld
Stadtwerk Winterthur, Kehrichtverwertungsanlage	Winterthur
SARS Stiftung Autorecycling Schweiz	Bern
TBF + Partner AG	Zürich
Toggenburger Unternehmungen	Winterthur
Trumag Aufbereitungsstechnik AG	Frutigen
VBSA	Bern
Verband KVA Thurgau	Weinfelden
VETROSWISS	Glattbrugg
WIEDAG AG	Oetwil a.S.
Zweckverband für Abfallverwertung Bezirk Horgen	Horgen

Financial Report

Income Statement

	Statement 2013 in CHF	Budget 2013 in CHF	Statement 2012 in CHF
Income			
Donors	875 901	785 000	785 340
Other income	–	20 000	–
Interest	1 332		2 800
TOTAL INCOME	**877 233**	**805 000**	**788 140**
Expenditure			
Materials	24 847	40 000	50 480
Analyses	73 072	90 000	98 615
Third party services	79 689	115 000	90 335
Salaries	465 348	470 000	423 861
Social security	106 834	105 000	98 797
Trainings	565	5 000	949
Rents	0	5 000	0
Maintenance/Optimization	28 877	65 000	20 115
Administration costs	7 970	3 000	337
IT	1 909	0	0
Advertizing costs	0	3 000	7 612
Cost of representation	1 928	0	6 993
Foundation board expenses	1 922	2 500	5 861
Technical advisory board expenses	1 294	2 500	300
ZAR operational expenses	4 884	5 000	3 403
Bank expenses	16	0	12
Miscellaneous	0	20 000	0
Total EXPENSES	**799 104**	**926 000**	**807 671**
RESULT	**78 128**	**-121 000**	**-19 531**

Balance Sheet

	31.12.2013 in CHF	31.12.2012 in CHF
Assets		
Raiffeisen Uster CH22 8147 1000 0047 5263 5	1 164 412	1 025 660
Debtors	0	60 340
Input taxes on debtors	45 102	44 836
Withholding taxes on deptors	333	2 084
TOTAL ASSETS	**1 209 847**	**1 132 920**
Liability		
Creditor	22 038	84 748
Sales taxes on creditor	0	6 650
KEZO	545 892	456 196
Sales taxes	0	0
Transitory liablities	63 699	85 235
Foundation capital	100 000	100 000
Project reserve	400 090	419 621
TOTAL LIABILITY	**1 131 719**	**1 152451**
ANNUAL RESULT (PROJECT RESERVE)	**78 128**	**-19 531**

Activities 2014

ZAR Project

4 THERMORECYCLING

RESH
Mixed Plastic – Electronic waste
Contaminated substrates

5 PRODUCT DEVELOPMENT AND MARKETING

Aluminum (0.2–1.0 mm)
NF precious metals / rare metals (0.1–0.7 mm)

8 COARSE BOTTOM ASH

Detail engineering bottom ash treatment plant
Construction and start-up

9 LARGE SCALE BOTTOM ASH TREATMENT PLANT

Logistics
Unloading at the treatment plant
Optimization of the plant

10 ANALYTICS

State of the art
Evaluation of analytics (differences between metals and oxides)
Melting trials for NF metals

11 STATE OF THE ART

Evaluation state of the art
Specification state of the art

12 SEWAGE SLUDGE ASH (KSA)

Further use of sewage sludge ash concentrated with phosphor
Production of inert material (chemical washing with depletion of P)
Utilization/production of building additive (chemical washing w. depletion of P)

M1 MINERAL FRACTION IN THE BOTTOM ASH

Characterization and potential of the mineral bottom ash
Product specification
Product development

M2 LANDFILL

Landfill behavior (laboratory tests)
Aluminum oxidization (Gas formation)
Eluate behavior

M3 BUILDING MATERIALS

Cement trials (Jura Cement)


1st Quarter 2014
2nd Quarter 2014
3rd Quarter 2014
4th Quarter 2014
1st Quarter 2015

Caption

Front	Pure zinc from elektro filter ash from waste-to-energy plants (FLUREC process/KEBAG)
5	Visualization of dry discharge line 1 at KEZO
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7	Visualization of internal processing at the new large-scale treatment plant for dry bottom ash in Hinwil
8	Prototype of a dust-proof conveyor belt (TRUMAG AG)
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11.2	Rotary divider in action
11.3	Bottom ash lumps from RESH trials
13.1	Powder pill for XRF analysis
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14	Color test for pigments
15.1	WTE electro filter ash as raw material for zinc extraction
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21	Triple deck with magnetic and eddy current spearators for the new large-scale treatment plant for dry bottom ash
24	Exhaust duct of air separating tables for fraction 0.2–1.0 mm
Rear	Part of process diagram of the new large-scale treatment plant for dry bottom ash in Hinwil by ZAV Recycling AG

Imprint

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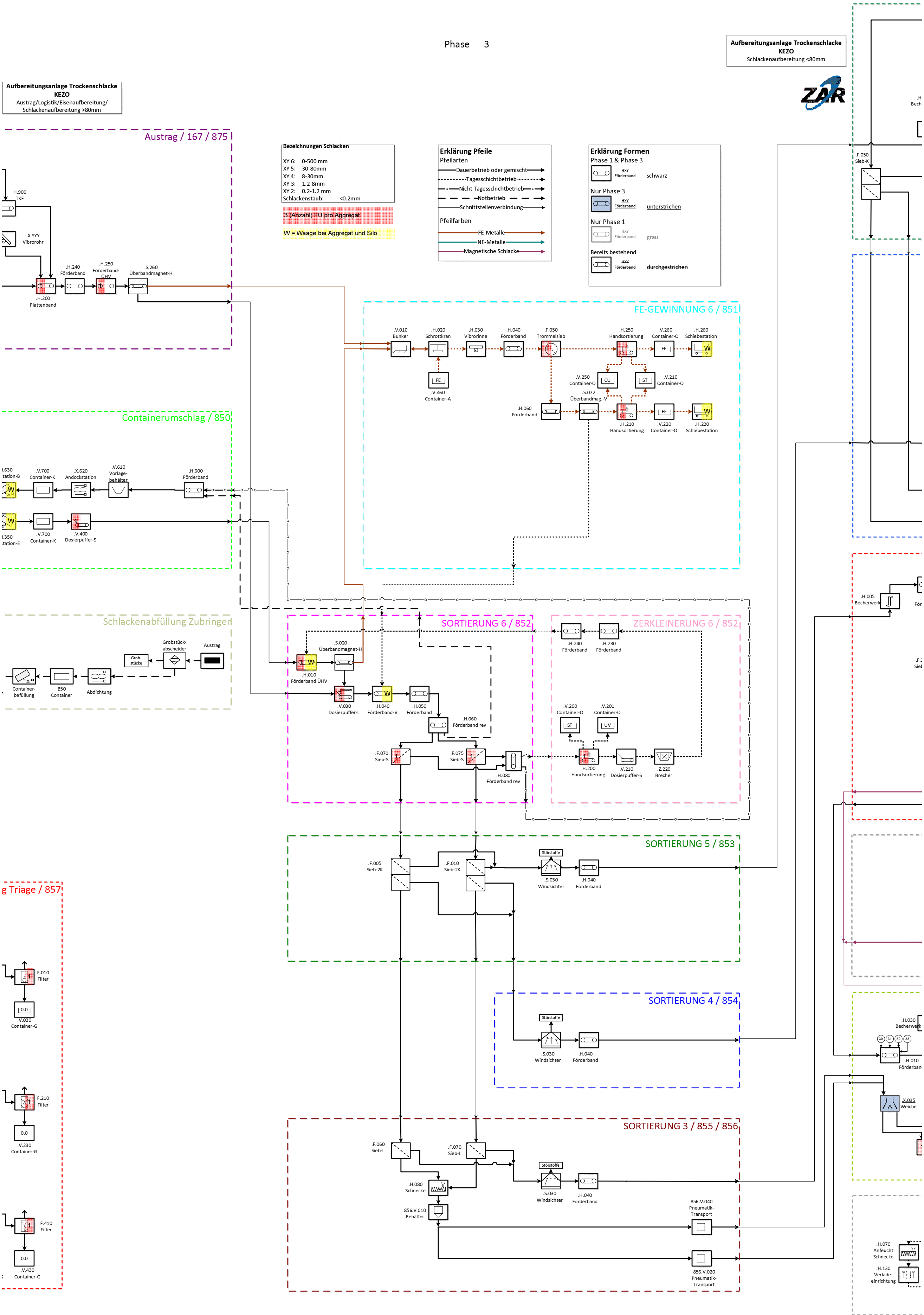
Phase 3



Aufbereitungsanlage Trockenschlacke
KEZO
Schlackenaufbereitung <80mm
Aufbereitungsanlage Trockenschlacke
KEZO
Austrag/Logistik/Eisenaufbereitung/
Schlackenaufbereitung >80mm
Bezeichnungen Schlacken
XY 6: 0-500 mm
XY 5: 30-80mm
XY 4: 8-30mm
XY 3: 1.2-8mm
XY 2: 0.2-1.2 mm
Schlackenstaub: <0.2mm
3 (Anzahl) FU pro Aggregat
W = Waage bei Aggregat und Silo
Erklärung Pfeile
Pfeilarten
Dauerbetrieb oder gemischt
Tagesschichtbetrieb
Nicht Tagesschichtbetrieb
Notbetrieb
Schnittstellenverbindung
Pfeilfarben
FE-Metalle
NE-Metalle
Magnetische Schlacke
Erklärung Formen
Phase 1 & Phase 3
schwarz
Nur Phase 3
unterstrichen
Nur Phase 1
grau
Bereits bestehend
~~durchgestrichen~~
Austrag / 167 / 875
.H.900 TKF
.X.YYY Vibrorohr
.H.200 Plattenband
.H.240 Förderband
.H.250 Förderband-ÜHV
.S.260 Überbandmagnet-H
FE-GEWINNUNG 6 / 851
.V.010 Bunker
.H.020 Schrottkran
.H.030 Vibrorinne
.H.040 Förderband
.F.050 Trommelsieb
.H.250 Handsortierung
.V.260 Container-O
.H.260 Schiebestation
.V.460 Container-A
.V.250 Container-O
.V.210 Container-O
.S.072 Überbandmag.-V
.H.060 Förderband
.H.210 Handsortierung
.V.220 Container-O
.H.220 Schiebestation
Containerumschlag / 850
.V.700 Container-K
.X.620 Andockstation
.V.610 Vorlage-behälter
.H.600 Förderband
.V.700 Container-K
.V.400 Dosierpuffer-S
Schlackenabfüllung Zubringen
Grobstück-abscheider
Austrag
Container-befüllung
850 Container
Abdichtung
SORTIERUNG 6 / 852
.S.020 Überbandmagnet-H
.H.010 Förderband ÜHV
.V.030 Dosierpuffer-L
.H.040 Förderband-V
.H.050 Förderband
.H.060 Förderband rev
.F.070 Sieb-S
.F.075 Sieb-S
.H.080 Förderband rev
ZERKLEINERUNG 6 / 852
.H.240 Förderband
.H.230 Förderband
.V.200 Container-O
.V.201 Container-O
.H.200 Handsortierung
.V.210 Dosierpuffer-S
.Z.220 Brecher
SORTIERUNG 5 / 853
.F.005 Sieb-2K
.F.010 Sieb-2K
Störstoffe
.S.030 Windsichter
.H.040 Förderband
g Triage / 857
F.010 Filter
.V.030 Container-G
F.210 Filter
.V.230 Container-G
F.410 Filter
.V.430 Container-G
SORTIERUNG 4 / 854
Störstoffe
.S.030 Windsichter
.H.040 Förderband
SORTIERUNG 3 / 855 / 856
.F.060 Sieb-L
.F.070 Sieb-L
.H.080 Schnecke
856.V.010 Behälter
Störstoffe
.S.030 Windsichter
.H.040 Förderband
856.V.040 Pneumatik-Transport
856.V.020 Pneumatik-Transport
.F.050 Sieb-K
.H.005 Becherwerk
.H.030 Becherwerk
.H.010 Förderband
.X.035 Weiche
.H.070 Anfeucht Schnecke
.H.130 Verlade-einrichtung