AN INTEGRATED APPROACH OF WASTE ISSUES ON METALURGICAL SITES

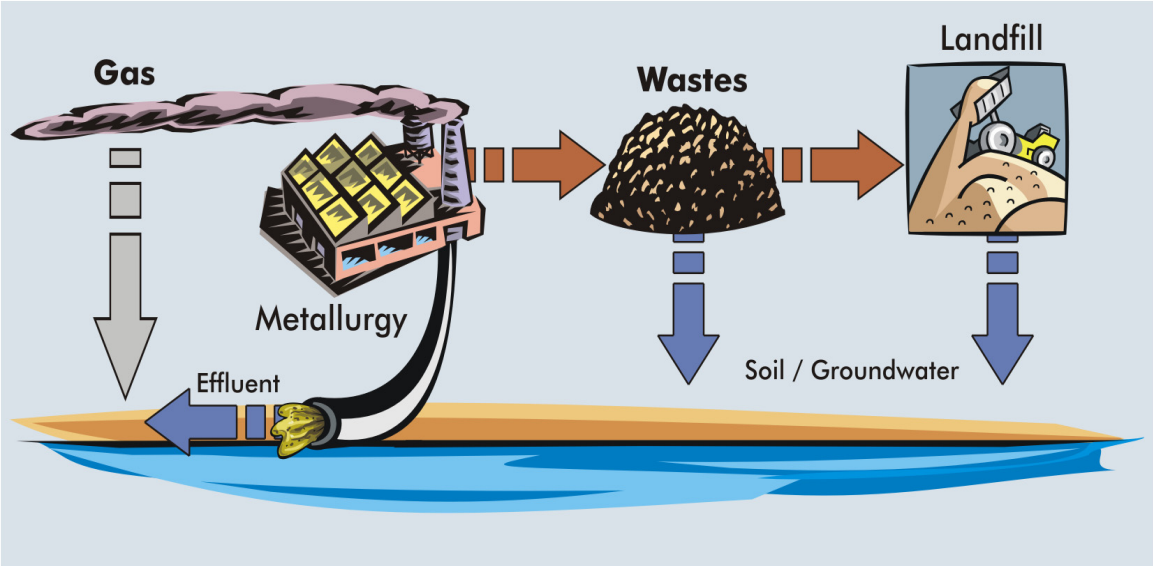
Gaspard Devos
Paul Wurth S.A. Luxembourg

1. A NEW CONTEXT FOR METAL INDUSTRY

Producers and owners of industrial extractive sites are living hard times due to Environmental pressure and liabilities.

This is valid whatever the region in the world, it is just a question of time.

On one hand, the normative environmental pressure is increasing through more severe regulations and controls on all pollution sources and production materials.

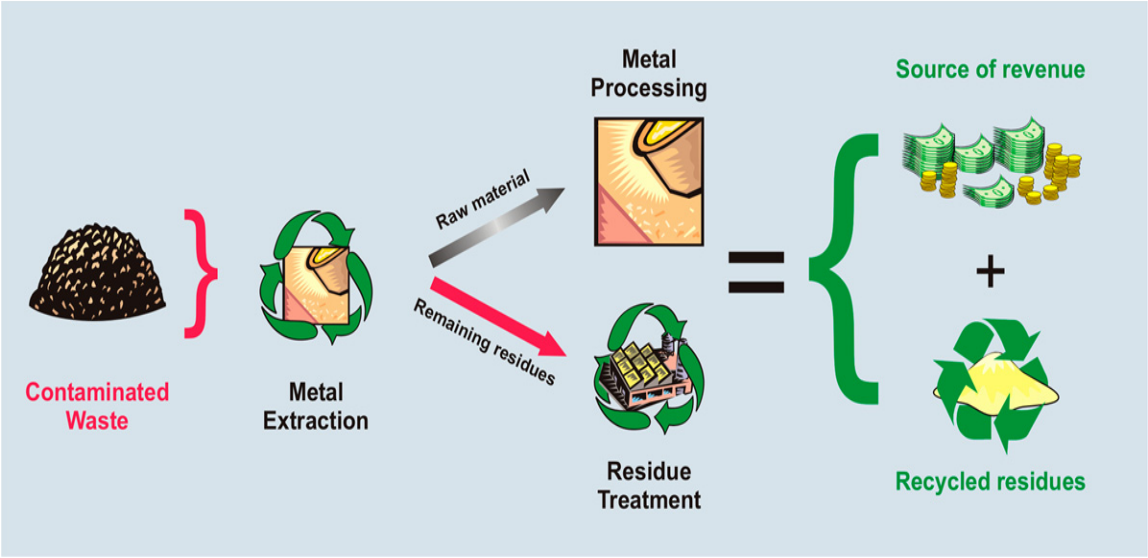


Furthermore, more impurities are extracted and captured, more the volume of the related wastes is increasing. But disposal costs are increasing, disposal areas for wastes are restricted, markets for wastes are limited and technologies for waste treatment are, most of the time, not available.

On the other hand, for most of the extractive industries, the costs required to get access to refine primary raw material are killing the profitability of the industry.
Definitively, a technological and economical breakthrough is ongoing: extractive industries have to increase their feed from secondary material and to be involved more and more with the recycling business.

The challenge is clear: the market of the future is moving toward the recycling of wastes and the extraction and the valorisation of waste material content.
Doing so, waste will become valuable material.

And suddenly, environment is not anymore a fate but an economical opportunity.



2. THE ENVIRONMENTAL CHALLENGE

2.1. Unlocking the Barriers to the Recycling of Waste and the Extraction of the Value

From the point of view of the "owner" of the contamination and/or the waste, several barriers are existing before recycling of waste and remediation of sites can be initiated and implemented. Such barriers can be technological, economical, commercial and political.

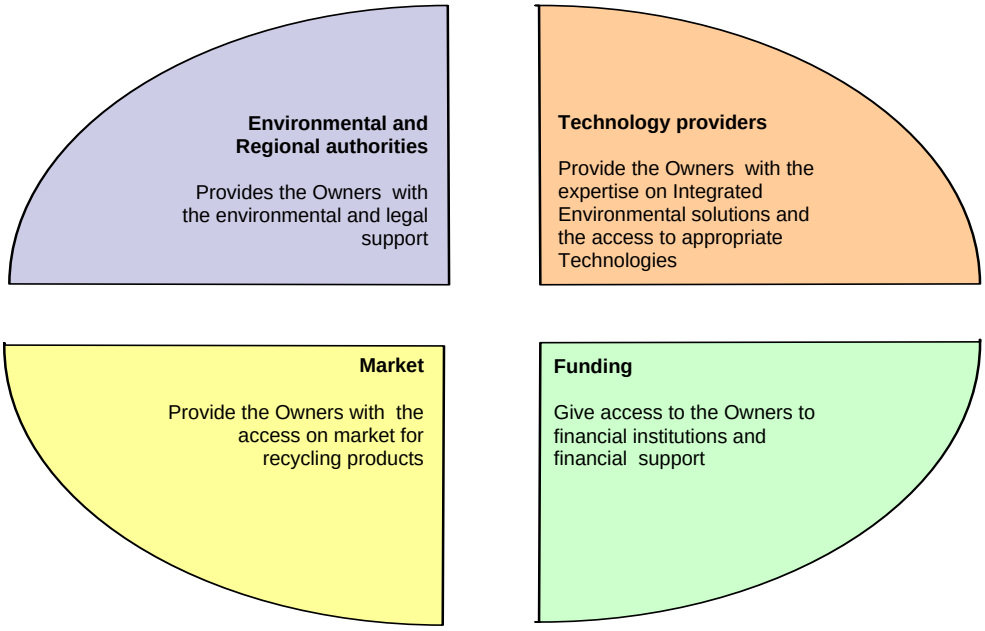
The owner, willing to implement a recycling and/or a remediation project preventively or under request of public authorities is facing a lot of questions, such as:

- how to get access to technologies which can reduce the environmental risk and limit the environmental liabilities
- how to get access to subsidies and financing supports for developing technological solutions
- how to get access to financial support for necessary investment
- how to get access to recyclers of wastes and get interesting profit from valuable materials
- how to get a clear and definite normative frame from the environmental and regulating authorities
- how to get support from the environmental, regional and national authorities in order to get the necessary permits.

Only positive and constructive answers to all these questions can make the project proceeding. Several stakeholders are involved, with different interest and different priority.
The project can fail or be delayed, if one of these stakeholders is not fully supporting the project.

2.2. Combining Stakes With Efficiency

It is clear that Recycling business can only be engaged if stakeholders are working together and combining their efforts from the early stages of the project starting from the project definition up to the complete implementation of the project and its after care and monitoring.



2.3. Operator Environmental Targets

The core activity of the extractive industry is to selectively extract from a raw material only a part of the elements and compounds according to their valorisation process, all the rest being considered as undesirable but unavoidable elements and compounds. All these undesirable sub products can be found in the gas, in the waste water, in the wastes and, for some sites, in the soil as a result of the migration of some elements.

The main environmental targets of the owner of these extractive sites are:

- Address properly environmental liabilities in relation with emission, immission and possible contamination
- Minimize gas and dust emission
- Minimize the use of water
- Minimize the generation of wastes

- Minimize the volume and/or hazardness of discharged gas, liquid effluent and solid wastes
- Optimize the recycling/reuse of wastes
- Get flexible treatment facilities adapted to the market
- Get flexible treatment facilities leading to safe disposal
- Optimize the construction and the management of waste storage

Each of such issues are interrelated and finally the owner has to deal with final sub products, generally under solid form, to be handled and managed properly, without affecting the overall profitability of the extraction business.

Presently, most of the sub products are considered as wastes and are landfilled.
Such landfills, beyond the huge surface area required and the long term operation and monitoring costs to be charged, are presenting a huge environmental liability which will remain a legal exposure during the whole existence of the dumps and landfills, even if properly closed. Most of the closure or capping is only an intermediate solution, which cannot provide any long term guarantee.
Our future generation will have to afford the removal and the cost of treatment of such waste products.

Our future shall be to find alternatives to the landfilling, and to develop and implement "Zero waste" approaches.

3. HOW TO UNLOCK THE BARRIERS?

As such, metallurgical wastes have no real value since they cannot be further used because of: absence of markets, regulations, costs,…but they are containing various elements and compounds, which can be valorised, when correctly separated and concentrated.

Such sub products, if correctly concentrated, can address secondary raw material market and may be very competitive compared with primary raw material, which are becoming more and more restricted and not in line with sustainable businesses.

Such sub products have to be included in a recycling approach in order:

- to decrease and limit the overall environmental liabilities related to those sub products,
- to maximize the valorisation of their content
- to provide sustainable and long term feed for the industry
- to limit the volume of residual wastes to be landfilled

A “zero waste” approach through recycling is the best alternative to landfilling.
The real challenge is to make it feasible and break all barriers for the implementation of the treatment of wastes and the recovery of sites.

This approach can be implemented in two main ways:

- **Preventive way,** applied on the extraction and refining steps in order to limit the regeneration of wastes on existing ponds, landfills, piles etc.

- **Remedial way,** applied through the extraction and so, recycling the soils and historical residues.

4. ACTING IN A PREVENTIVE WAY

Such way is implemented by owners and operators of extractive metallurgy, who decide to react preventively before to store a waste into landfill and so to limit directly their exposure.

4.1. Targets

The main targets of the owners and the operators who decide to react preventively are environment oriented:

- Minimize the use of water
- Minimize the generation of wastes
- Minimize the volume and/or hazardness of discharged liquid effluent and solid wastes
- Maximize the recycling/reuse of wastes
- Get flexible treatment facilities adapted to the market
- Secure treatment facilities adapted for safe disposal
- Optimize the construction and the management of waste storage.

…but also economically oriented:

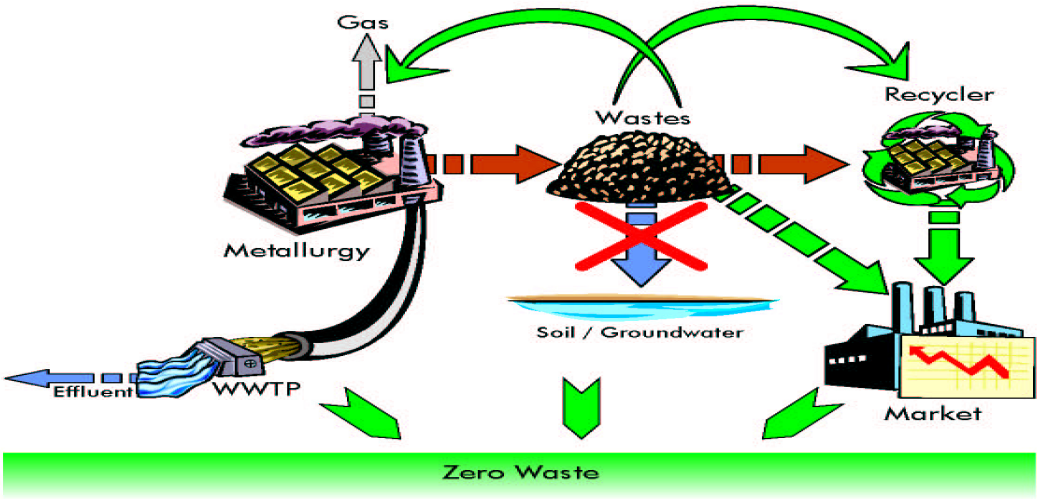
- Get the best benefit and return from the global sales of all sub products.
- Minimize the treatment charges
- Minimize the landfill costs
- Minimize the financial exposure related to the storage and landfilling of waste.

4.2. Solutions

Such preventive attitude has to be done through the reengineering of the production flow sheet itself and the introduction of technological solutions in order to get an integrated environmental approach, in terms of:

1. Management of gas, water and wastes before treatment and landfilling
2. Global solutions addressing gas, water and wastes
3. Market evaluation for the alternative residual products
4. Selection of process and technology adapted to the market

Such integrated approach must be initiated through a reassessment of all the relations between the flows:



4.3. Barriers

Several barriers are to be correctly considered and managed, such as:

- High level of investment
- Technology not always available
- Market not always existing / accessible
- Restrictions on transport of waste products
- Administration procedures

4.4. Drivers

Appropriate actions have to be defined in order to manage correctly such barriers and to try to remove them through:

- Access to subsidies for technology development and studies
- Trading expertise during technology definition
- Access to support from banks for investment
- Interest of recyclers
- Proven benefit from products
- Flexibility and support from the legal authorities for waste transport and treatment

4.5. Successful Case

Recycling of various industrial residues (dust and sludge) generated from the iron and steel industries by a recycling plant, PRIMOREC S.A., located at Grand Duchy of Luxemburg:

Context:

All over the world, the iron and steelmakers have to comply with more and more stringent environmental regulations. Gas, liquid and solid wastes and effluents have to be correctly captured and made stable and innocuous.
For any iron and steel company, such compliance means high compulsory investments without any cash return. In the case, a process exists for solving the problem.
In other cases, such processes don't even exist and solving the problem only means cost draining for disposing residues on a proper way. It is definitely a fate.

In the steel industry, minimills have multiplied during the last decades as an alternative to traditional blast furnaces. These minimills are recycling steel and iron scraps through electric arc furnaces (EAF). These scraps are coming from the steel processing industry and from end use metallic products.
A large part of these metallic scraps is galvanized. Consequently, dusts and sludges generated by the gas and water treatments are containing Zinc (up to 40 %), iron (up to 40 %) and other non ferrous metals (lead, copper, manganese, etc). These dusts are collected and have to be either recycled or dumped.

Dumping is nothing but cost draining and environmental liabilities. Therefore, iron and steelmakers are looking for better and more economical solutions. The best solution is the extraction of the contained valuable elements in order to avoid any disposal and to generate return from these elements.

Research and investigations have been developed during the last two decades. Some of them resulted in industrial implementations but not a single one ever solved completely both environmental and economical issues.

Adapted solution:

The PRIMUS® Process has been developed by Paul Wurth S.A., setting up a "process combination" aiming to solve here above mentioned issues i.e. treatment of zinc bearing iron residues, valorising mainly the Zinc as Zinc Oxides or Zinc SHG and the Iron under Pig Iron form but valorising as well other elements like Ag, Cu and Pb.

The PRIMUS® Process has been implemented and operated by PRIMOREC S.A. and is treating mainly EAF dusts and producing Pig Iron as well as Zinc concentrate. The residual products are consisting in limited quantity of clean and inert slags meeting the requirements for road backfilling and construction material.

The development was financed by Arcelor, public authorities and development banks.
The project was supported by a strong marketing action, consolidated through traders.
The local authorities were involved from the beginning of the project and supported its implementation.

The Plant was commissioned in 2003 and the first operational results are very promising and have demonstrated the expected economical and environmental benefits of such recycling activities.

PRIMUS® Process at PRIMOREC – Luxembourg -

5. ACTION IN A REMEDIAL WAY

Similarly the remedial approach is applied through the extraction and recycling of valuable materials from the soils and from storage of waste generated by historical and/or ongoing production.

Such approach is addressed to owners and operators of extractive metallurgy who decide to find solutions for limiting their environmental liabilities.

5.1. Targets

The targets of the owners and the operators who decide to remediate their waste storages and their sites are also environment oriented but the main difference is that the wastes to be treated have already generated long historical liabilities for which solutions have to be found in order to:

- Decrease the volume and/or hazardness of stored liquid effluent and solid waste,
- Maximize the recycling/reuse of wastes,
- Get flexible treatment facilities adapted to the market,
- Implement treatment facilities adapted for safe disposal,
- Optimize the construction and the management of waste storage,
- Secure the long term evolution of the remediated areas.

Similarly, economical targets are defined in order to:

- Get the best benefits and returns from the global sale of all sorted sub products,
- Decrease the landfilling costs
- Minimize the financial exposure related to the storage and landfilling of wastes and to the contamination of the sites.

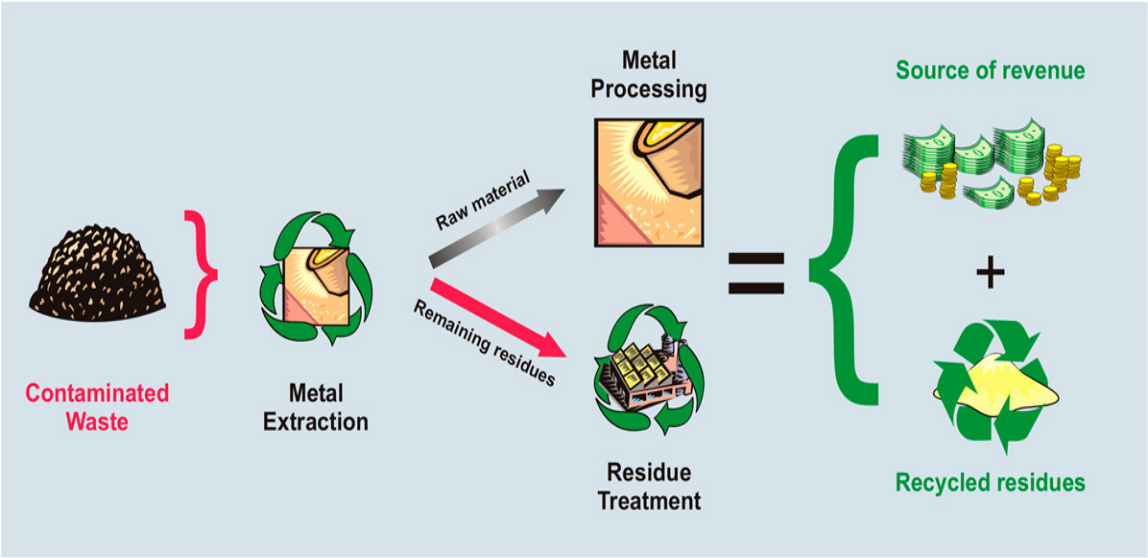
5.2. Solutions

Before proposing remedial solutions for contaminated sites, a long and complex investigation is necessary in order to understand the history of the production and of the deposit and, also, to identify the extent of the migration and distribution of the elements.
Such investigation will lead to consider more complex solutions through the reengineering of the site remediation technology in order to get finally an integrated environmental approach, aiming to:

1. Select well adapted processes and technologies
2. Get value out of the waste products
3. Get “inert” material if not recyclable

Technological solutions shall be based on the following sequence:

- Sorting and extraction of the valuable (mainly metal) and /or reusable part of the waste and of the contaminated sites.
- Processing and concentration of the valuable part (metal) part according to the potential market (opportunities, trading value)
- Treatment of valuable part according to market opportunities
- Recycling of residual products



5.3. Barriers

Several main barriers have to be correctly considered and managed, such as:

- The high level of investment, which can be required
- The non availability of technologies
- The non accessibility of the markets
- The restriction on transport of waste products
- The administration procedures
- The access to contaminated material (evaluation, excavation, …)
- Large volume with low content of valuable material
- Historical understanding

5.4. Drivers

Similarly to the preventive approach, a remedial program requires appropriate actors to be involved in order to correctly manage the here above barriers and try to overtake them through:

- Access to subsidies for technology development and studies
- Trading expertise from the early stage of the project (during technology definition)

- Access to support from banks for investment
- Interest of recyclers
- Proven benefit from products
- Flexibility and support from the legal authorities for waste transport and treatment

5.5. Remediation and Recycling – Typical Case

Context:

One of the main issues of non-ferrous metallurgy is to address correctly pollution and possible damages generated from the past activities of the plant.
Such sites are containing generally huge volume of contaminated material under the form of abandoned facilities, waste dumps, full ponds, contaminated soil, and contaminated ground water. The contamination is by essence composed of non-ferrous metals such as Cu, As, Pb, Zn. Also generally, the distribution of the contaminants is very diffuse and large due to the acid content in the soil and the migration to ground and open surface water.
High environmental risks are existing mainly if the sites are located in an agricultural area and at the close to cities.

Successful approach:

All stakeholders (owner, banks, government, NGO's, municipalities, public opinion) are put around the table and committed from the early stage of the project, to support the necessary preliminary investigation and the organisation of a strong project team having access to recycling technologies.
Development Banks can play an important role, being motivated by the difficult economical, social and environmental context and can agree to finance a part of the remediation program, provided the Owner is committed to the economical and social development of the region.

The project has to be implemented in a spirit of transparent and open communication.

A typical technological approach on Site Remediation in terms of decontamination and pond/dump closure:

- Sorting and removal of valuable waste from the contaminated sites
- Valorisation of valuable material (Iron, Stainless Steel, Pb, Cu,.. with specific treatment)
- Optimal reuse of material (as an example demolition wastes used as drainage material part of the closure of the waste pond/dump)
- Residual waste used as filling material, part of the closure/consolidation of the waste pond/dump
- Confine the residual historical contamination in the slime pond area

- Covering of the top of the waste pond/dump with a multi-layered cover to avoid future infiltration of water
- After care program

Benefits:

- Environmental outputs achieved
- Maximum valorisation of the wastes
- Remediation costs reduced
- Reuse of land

6. LEARNINGS AND CONCLUSIONS

- Waste can generate revenues

- Global solution minimizes the overall costs of the investment and attract funding

- Recycling and valorisation of wastes reduce the liabilities and provide environmental benefits

- Appropriate Project Management ensures the respect of the timing, of the budget and of project requirements.

Mr. Gaspard Devos Luxembourg, June 2005

Paul Wurth S.A.
32, rue d'Alsace
L-1122 Luxembourg

Tél. +325 49 70 481
Fax. +352 49 70 9481
E-mail: Gaspard.devos@paulwurth.com