

## **Accidents and occupational diseases prevention in waste treatment sector: CITEC guidelines**

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CITEC is the Italian acronym of Committee on Technologically Complex Systems, a workgroup founded 1997 with the purpose to draft guidelines for an integrated system of municipal waste management, involving problems connected with location, design, building and managing of each plant, from an environmental point of view. The workgroup is composed by many specialists belonging to national and local Institution, Universities, companies, freelancers, whose experience and synergic interaction has allowed to reach a global overview about problems linked to waste treatment plants.

CITEC Guide Lines represent Italian Best Available Techniques (BAT) relevant to municipal waste treatment. BAT were introduced by EU IPPC Directive on the prevention of environmental pollution highlighting plant emissions, waste production and discharges. BAT aren't specific technologies to be adopted compulsorily, but only a reference for defining acceptable emission levels which, regardless of the engineering solution adopted, must not exceed the levels of the most favourable technologies which the market actually makes available.

Therefore, BAT are a set of procedures, technologies, techniques, way of maintenance, operating standards, efficiency checks, monitoring systems that ensure a reduction of environmental pollution, including design, construction, maintenance, operation and site restoration after dismissal.

Since 2006, the Committee has included the new aspect of safety at work, beginning a collaboration with a workgroup of the Technical Advisory for Risk Assessment and Prevention (CONTARP) of the Italian Workers Compensation Authority (INAIL).

INAIL carries out studies and surveys on the dynamics of the accident phenomena and of professional diseases, both in general and in specific types of risk or in different workplaces. One of these studies, under the responsibility of CONTARP professionals, has the aim to improve health and safety at work in waste management plants (thermal treatment plants; selection systems; biological treatment plants; W.E.E.E processing), through the detection of hazardous situations, the workers' risk assessment and the identification of the necessary and adequate actions to prevent, remove or reduce the different risks in these workplaces.

INAIL contribution to safety and prevention at work in CITEC Guide Lines was based on a whole plant life approach, from design to dismissal.

The suggested preventive and protective actions may be considered as good practises for health and safety at work. According with the European Agency for Safety and Health at Work, the implementation of a "good practise" should lead to reduce permanently the whole potential to cause harm to workers, preventing the identified risk at source, and to improve working conditions, with a cost efficient reduction of risk. As a consequence, a good practice is not necessarily the best. Therefore, good practises are a set of guidelines, case study examples demonstrating an actual, evident effect on the prevention of workplace risks, on production processes, and on training, operating

standards, checklists, promoting effectively health, safety and efficiency and help in meeting relevant legislative requirements of the Member State in which it has been implemented.

As it is shown, the meanings of BAT for environmental protection and good practices for safety at work are strongly connected. The understanding of these merging points and the consequent meeting of minds have led to the new challenge in waste treatment plants: from life environment to working environment care, on the basis of the concept of prevention as the main and the first solution to guarantee workers' safety and health and an adequate environmental protection, also in agreement with enterprises and their demands.

## 1. Current state of Safety and Health in Municipal waste treatment facilities in Italy

Most of concerns about waste treatment plants in Italy are focused on the environmental impact on the population living in the surrounding areas, rather than on health and safety at work conditions.

For this reason, the challenge for Italian waste treatment enterprises is to take care not only of environment, even working environment, but also to working-man health.

The following tables show some data on waste sector enterprises, on trend of accidents in Italy for the whole sector and of accidents and occupational diseases for enterprises involved in some specific waste processing operations.

**Table 1 Total Municipal Waste Sector - INAIL data for Italy 2006**

Enterprises	Employees	Accidents	Increase 2005-2006
53168	293314	22183	2,7%

As shown in the tables, there is the trend for weak reduction in the number of accidents.

**Table 2 Municipal Waste Treatment accidents**

Year	Accidents	Accident compensations			
		Temporary Disability	Permanent Disability	Death	Total
2004	8.842	7.292	272	9	7.573
2005	8.559	6.989	249	5	7.243
2006	9.350	7.464	202	7	7.673

The number of occupational diseases is expected to increase with time, mostly because most of plants are quite recent and, consequently, worker exposition.

**Table 3 - INAIL Data for specific operations**

Operation	Year	Accidents	Occupational Diseases	Total
Incineration <sup>1</sup>	2002	402	1	403
	2003	77	0	77
	2004	41	3	44
Recycling <sup>2</sup>	2002	10	0	10
	2003	15	0	15
	2004	28	0	28
Incineration <sup>3</sup>	2002	12	1	13
	2003	8	0	8
	2004	10	0	10

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## **2. Approach and methodology of investigation**

INAIL professionals from CONTARP have developed procedures for safety investigation on complex system, such as ones involved in municipal waste processing. INAIL scope is the improvement of safety and health condition to be reached by means of specific knowledge of technologies and related hazards, to be compared with actual situation of existing plant. Result of these studies may vary, but, anyway, apply the approach philosophy, synthetically shown in figure 1.

First of all, it is necessary a detailed description of systems and process under investigation, and also historical data from INAIL data base are collected. Process hazard are then identified, and subsequent surveys and technical analysis of existing installations permit a definite risk assessment.

Once risk are assessed, all involved process and risk factors are considered in order to establish possible solutions, i.e. applicable prevention measures, to eliminate or reduce impact on employees.

Results are validated and standardized, where possible, with a deep consideration of similar plants or, where these measures are applied for the first time in this sector, after an initial phase of application.

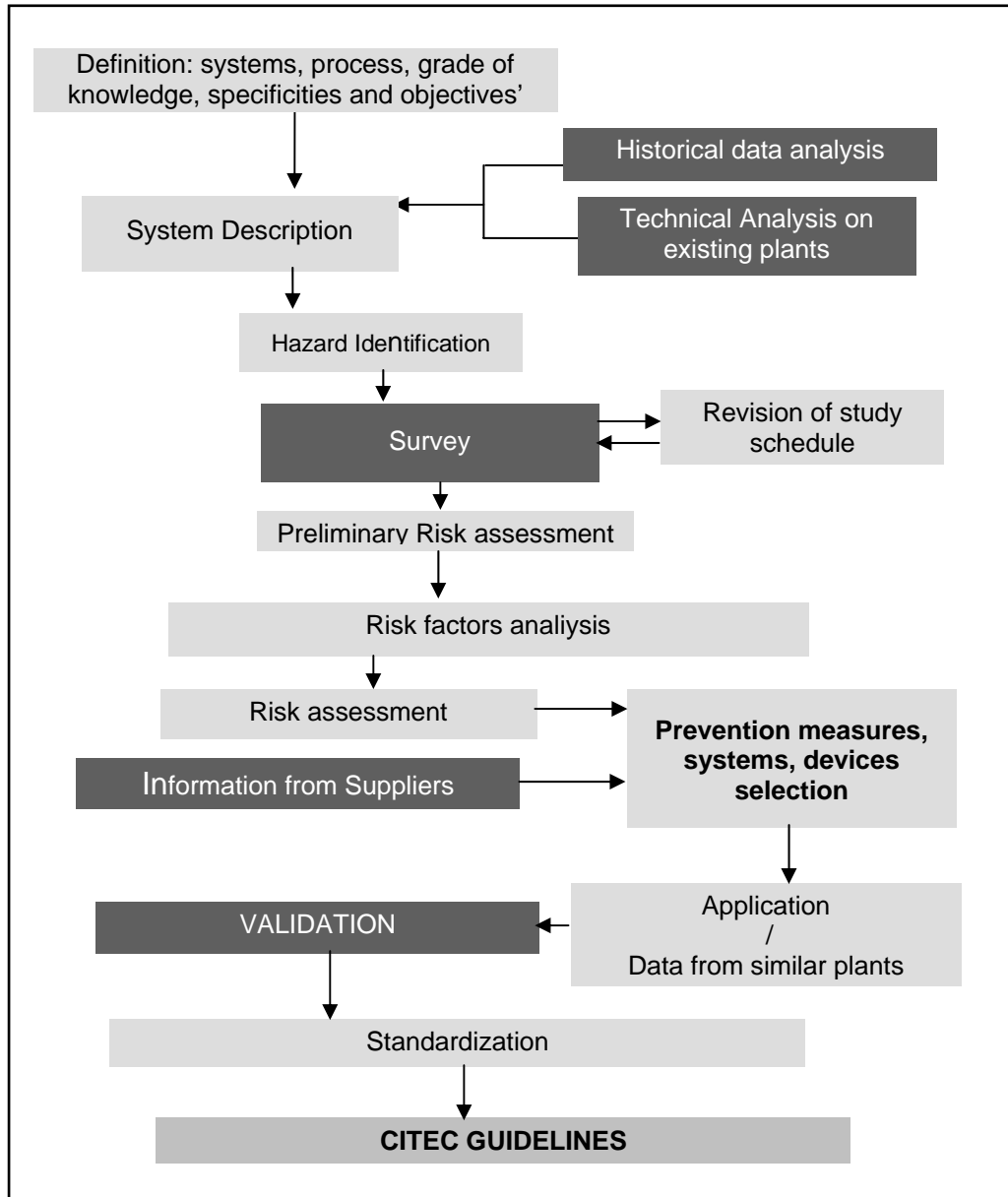
Follow-up is necessary to ensure that the level of safety is maintained, and continuous improvement is achieved. All collected data, experiences and results were reported as a INAIL contribution to CITEC Guidelines.

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<sup>1</sup> Management of Municipal Waste Incinerators by Industry Sector enterprises

<sup>2</sup> Mostly by Service Sector enterprises

<sup>3</sup> Management of incinerators by Craftsmanship Sector enterprises



**Figure 1 – Approach and Methodology Block flow diagram**

### **3. CITEC Guidelines Section Z**

CITEC Guide Lines section on safety and prevention contains principles, objectives and the main preventive and protective measures to remove or, at least, reduce workers' risks. Section is organized for kind of risk, type of waste treatment plant and processing phase.

Preventive and protection measures, as a complex of organizational or procedural measures, process and equipment and health, are:

- organizational actions: set of actions connected to workers' and employers' role and tasks, including education
- technical actions: action implying use and management of equipment, or parts of it, structures and structural components to protect employees from risks or, at least, to reduce the probability of damage
- procedural actions: specific and detailed series of actions, acts or operations which have to be executed in the same manner in order to eliminate or reduce risks for employee's safety.

The whole body of measures has to be intended as "good practises", meeting the relevant legislative requirements, effective and demonstrating steps and methods that can be taken within a workplace or within an organization to improve working conditions or/and reduce health and safety risks at enterprise level.

Suggested solutions are chosen mainly to highlight preventive actions in order to reduce the probability of risks; protective ones, collective and individual, minimizing damage when it occurs, are mentioned only when it's strictly necessary.

In high technology plants, risks in workplace, their synergic effects and preventive measures have to be constantly observed, above all where it's impossible to distinguish different jobs: depending on these observations, modifications to plant layout and to work organization may be necessary.

In order to verify the actual effectiveness of the adopted preventive measures and the achievement of the expected aims about safety at work, procedures and operating instructions have to be set up, applied and constantly verified to be updated. In this way, risk assessment is an iterative process leading to a continual monitoring of safety at work management.

Plants under consideration were:

- Selection systems
- Thermal treatments
- Anaerobic digestion, Aerobic treatments, Biomass
- Integrated systems for the treatment of municipal waste, other biological substrates and civil wastewater
- Inertization
- Landfill technological facilities
- Waste coming from Electrical and Electronic Equipment (W.E.E.E.) Processing

The following table shows some example of investigated processes.

**Table 4 Municipal Waste Processing**

Process		Reception	Pretreatment	Treatment	Post treatment	Complementary operations
MECHANICAL SELECTION		Waste handling : Discharge	Shredding Breaking Screening	Iron removal Screening Press		Refined material transport by conveyor belts
THERMAL TREATMENT SYSTEMS		Waste reception Remote-control rooms Automatic handling Manual handling of hospital waste Waste handling systems: fork lift truck				Energy recovery Flue gas treatment: <i>Dry Flue gas treatment</i> <i>Wet Flue gas treatment</i> <i>Dust and liquid waste collection DE-NO<sub>x</sub></i> Furnace maintenance
ANAEROBIC DIGESTION		Reception, warehousing	Handling and substrate preparation		Biogas captation, storage Combustion Compost production	Energy recovery General, auxiliary, hygienic- sanitary services Solid, liquid flows: <ul style="list-style-type: none"> <li>• maintenance</li> <li>• dehydration</li> </ul>
AEROBIC TREATMENTS		Reception, storage, movement and pre- treatment			Final storage	
INERTIZATION		Waste handling Discharge Temporary storage of raw waste	Shredding- Screening Interference elimination homogenization	INERTIZATION: Stabilization process Waste thermal destruction	FINISHING TREATMENT Inertized material storage	Waste sampling and analysis Treated material conveying systems Final storage Maintenance
LANDFILL TECHNOLOGICAL FACILITIES	LEACHATE MANAGEMENT/ TREATMENT	Collection		Membrane Processes Evaporation Fenton Process		
	BIOGAS TREATMENT	COLLECTION	Dedusting /sour gas absorption	Combustion		Energy recovery Flaring

Following to process analysis and identification, were also listed the possible actions to be undertaken, taking care that:

- risks at work are changing with technological progress and with the ongoing change of job activities
- preventive measures have to be continuously improved. For this purpose, a continuous monitoring system has to be applied organically.
- workers' health and safety care must be achieved and assured during the whole lifetime of each plant:
  - design
  - construction
  - management during standard exercise
  - ordinary and extraordinary maintenance and cleaning
  - dismissal.

We resume same recommended principles:

**Prevention and protection systems: general actions**

In order to reduce and eliminate risks, it's necessary to adopt the following measures and actions according to risk assessment.

**Organizational measures**

- ensure workplaces' hygiene
- ensure ambient monitoring
- ensure that every worker is properly informed about risks
- ensure that every worker is properly educated about safety at work and prevention, and about correct usage, maintenance and efficiency control of PPE.

**Procedural actions**

- reduce all hazard factors aging on: amount of goods in stocks; extreme process conditions within the plant; all other risk factors involving workplaces, organization and material agents
- set up, apply and update procedures to perform working activities
- set up, apply and update safety procedure for both periodic and scheduled and extraordinary maintenance of plants, devices, work equipment and machinery
- periodically verify the respect of legislative fulfilments concerning health and safety at work.

**Technical actions**

- whenever possible, eliminate or replace processes, materials, products and dangerous substances or replace them with less dangerous ones
- close off dangerous job activities improving plant automation or segregation
- conform workplaces, plants, machinery, devices, safety and control systems to the most recent technical standards.

## 4. Conclusions

The social relevance of this initiative consists in the merging of these basic themes, since now independent, with the actual common focus that is "prevention" (of environmental damages or of accidents and professional diseases).

Furthermore, international and national regulations become more and more specific on products (Life Cycle Assessment) and waste proper management has generated a considerable increase in the number of enterprises operating in waste treatment division. Depending on specific process utilized for waste disposal, a wide set of plant typology has been designed and constructed, with a broad range of complexity, employing operators for control and maintenance.

Waste treatment sector is rapidly expanding so that the number of operators is becoming wider and wider, and working conditions are often to be improved to an acceptable level.

Waste management enterprises social responsibility lies in taking care of environment against pollution, being aware that the positive consequences of applying “good practises” will ensure safe and healthy workplaces, too; the suggested practises on injuries prevention and workers protection, included in CITEC guidelines, are an effective support for a correct management of municipal waste treatment plants.

Main purpose of this study, whose outcome is flown into CITEC guidelines, is the prevention of work accidents and occupational diseases related to the multiple risk agents which are present in specific work places, where the synergic effects of these agents are not yet well known and may affect operators.

A wide number of papers and amount of reference material on prevention for this specific division has been produced, based on technical advices provided to enterprises. These contributions are a further step for the divulgation of best practices to be applied in specific and different kinds of waste treatment facilities, described in CITEC guidelines, whose 2008 English edition is expected in 2008, in order to highlight the worldwide waste question from a prevention point of view.