Application of Risk Analysis to landfills: the experience of Brescia (Italy)

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Abstract
This contribution describes the experience of the Province of Brescia, public body responsible for managing applications for landfill authorization, and its collaboration with the University of Brescia for the specific activity of risk analysis applied to landfills. After a reference to the current national legislation and a summary of the technical documents available for the topic (guidelines and instructions drawn up by technical bodies), the technical-preliminary approach applied by the Province of Brescia is outlined. This is complemented by a detailed description of the methodological approach followed for the evaluation of Risk Analysis documents and of the critical aspects that emerged within several administrative procedures. Finally, some issues on the topic of interest that emerged within a technical task force, involving Lombardy Region and its provinces, are introduced.
Keywords: authorization, critical issues, environmental risk, solid waste, waste landfilling

1. Introduction

In the Italian authorization procedure for the construction of a landfill, the Risk Analysis is mandatory in case of request for derogation from the current legislation (D.M. September 27, 2010), in order to demonstrate that there is no risk for the environment. According to the regional law n. 26 of 12th December 2003, since January 2009, the provinces of Lombardy have become the competent authorities for issuing authorizations for the construction and management of controlled landfills for inert, non-hazardous and hazardous waste (with the exception of plants for the disposal of waste containing asbestos). This competence is also expressed in the case of requests for derogation from the criteria of eligibility of waste in landfills. In order to comply with this competence, the province of Brescia developed its own protocol that has evolved over time following the experience gained.

2. Legal and technical framework

2.1. Current national legislation, guidelines and instructions

In the Italian legal system, the Ministerial Decree (D.M.) 27 September 2010 currently defines the procedures for the admissibility of waste in landfills. The risk assessment must demonstrate that there are no hazards for the environment, a necessary condition for issuing the authorization:

- to the sub-categories of landfills for non-hazardous waste (article 7 of D.M. 27 September 2010);
- to the exceptions to the limit values for the waste acceptance in landfills (article 10 of D.M. 27 September 2010).

In 2005 the APAT institute, now ISPRA (Higher Institute for Environmental Protection and Research), has published the "Methodological criteria for the application of absolute risk analysis to landfills" (APAT, 2005), but this technical direction has not been adopted so far as a mandatory tool.
The circular of the Ministry for Environment, Land and the Sea Protection, dated 30/06/2009 (MATTM, 2009), states that the risk assessment can be carried out in accordance with the APAT guidelines (2005). Furthermore, it explicitly mentions that the analysis can be limited only to the evaluation of the possible impacts on the environmental matrices (surface/underground water and air quality), as an indirect estimate of the human exposure to contamination from leachate and biogas, by assessing the vulnerability of environmental receptors that can be directly affected by landfill emissions. Only later, if the environmental risk is not met, it is advisable to carry out the health risk analysis in relation to the eventual toxic effects (carcinogenic and non-carcinogenic) associated with exposure to the considered substances.
The third national guideline for the specific topic is the ISPRA circular n. 36365 (ISPRA 2011), which clarifies some aspects for which no mandatory indications are set. For instance, the location of the point of compliance (POC) is fixed immediately below the potential source of contamination (landfill) on the vertical, at a distance of 0 meters from it. Therefore, any phenomena of contamination dispersion and dilution that is connected to the transport in groundwater up to the POC are not taken into account. Furthermore, the document proposes specific acceptability concentrations for DOC (Dissolved organic carbon) and TDS (Total dissolved solids).

2.2 Provincial technical-preliminary approach

Province of Brescia has followed what the abovementioned circulars have proposed and it has set other limits for unregulated aspects, for example by adopting for molybdenum the groundwater limit used in Germany (50 µg/l). Another addressed issue has been the codification of the height of the hydraulic head of leachate, a parameter that regulates the flow of contaminants in the aquifer. Finally, the province requires that site-specific data are obtained by means of on-site tests.

3. Methodological approach

3.1 Risk analysis for groundwater

Concerning the risk for the water resources, first the leaching factor (LF) and the lateral attenuation factor in groundwater (DAF) are calculated, according to the formulas reported by the APAT guidelines (2005, 2008) and by the ISPRA circular (2011). The consistency of the design parameters on which the calculation of these factors are based and the use of the principle of conservativeness in the choice of such values are verified.
Then a forward risk analysis is carried out in order to verify the risk in the POC and the respect of the instrumental detection limits in the POE (Point of Exposure). The starting points are the concentrations requested in derogation or those authorized for the sub-category.
As regards the definition of the maximum permissible concentrations in groundwater, the most restrictive values present in the national legislation are taken into consideration. As regards the instrumental detection limits, the limits provided by the ARPA (Regional Agency for Environment Protection) laboratory in Brescia are used.
The choices for locating POCs and POEs are critically analyzed, even crossing data from different sources.

3.2 Risk analysis associated with gaseous emissions

The risk associated with gaseous emissions, which is the risk for human health at the point of exposure, is assessed, for the relevant cases, for three different migration paths:

- (outdoor and indoor) inhalation of dust and particulate resulting from wind erosion and atmospheric dispersion;
- (outdoor and indoor) inhalation of vapors related to atmospheric dispersion of biogas;
- (outdoor and indoor) inhalation of vapors related to volatilization of substances from the leachate in groundwater.

The potential receptors are landfill workers for outdoor exposure and workers in the local office for indoor exposure.
For the calculation of transport, dispersion and volatilization factors, of Risk and of Hazard Index, the procedures and formulas reported by the APAT guidelines (2005) are used, with the exception of the case of indoor exposure for the biogas component, as far as described in section 3.3.
Finally, the total risk for human health is calculated, considering outdoor and indoor inhalation, as the sum of the risks for the three considered routes of exposure, and it is compared with the acceptable limits of both individual and cumulative risks.

3.3 Critical issues in risk assessment

The first step of the procedure for calculating the risk associated with gaseous emissions, which is the selection of the substances of interest, is a first criticality for all migration paths. In fact, it is not always possible to identify a set of substances of interest starting from scientific evidence or real data on comparable cases (referring to a list of CER codes).
Regarding the indoor scenario of the biogas component, inconsistencies in the formulas reported in the APAT guidelines (2005) emerged. The correct formulation was detected in the primary bibliographic source (Ferguson et al., 1995) and adopted in the province of Brescia.
Another issue is that the Italian legislation does not contain limits for CH_4 and CO_2 in the air (outdoor) that are substances present in the emissions related to the presence of biogas, of which they are the main constituents.

4. Lombardy Region technical task force: topics addressed and possible developments

Within the Regional technical task force, each province illustrated its own experience on the procedures adopted for the application of risk analysis to landfills. The need to adopt a regulatory simplification tool in order to standardize the assessment criteria for risk analysis applied to landfills throughout the region emerged.
The contents of such a regulatory tool are under discussion and the current hypothesis is to refer partially to the criteria defined by another Italian region (Veneto), integrating it with the assessment of biogas emissions (where applicable).

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