



Assessment of emerging and innovative techniques considering best available technique performances



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ABSTRACT

For the past 20 years, the European context has been policy-driven by several directives to reduce pollution, one of the most important for industries being the industrial emissions directive (IED). The IED's objective is to minimise pollution from various industrial sources throughout the European Union. One means of attaining the objective is to implement techniques which have at least the same performance as reference techniques called best available techniques (BAT) given at European level. The study of existing methodologies on performance assessment of proven or emerging techniques has made it apparent that there are none taking into account the 12 criteria proposed by the Annex III of the IED to evaluate technique performances. Even if innovative techniques are not considered by the IED, support to (public or private) researchers in their development in terms of assessment methodology must be proposed. This is what we present in this article.

The methodology based on a tree-structured information system (objectives, criteria, indicators) and a qualitative assessment of indicators (environmental, technical, economic and social) is an initial approach to an innovative technique assessment method considering BAT on laboratory or industrial scales. In an aim to adapt the criteria and indicators to a specific process, assessment methodologies must be adaptable. Our method allows for choosing indicators to comply perfectly with the process studied. Only the first level of the tree is fixed. The other branches could be adapted to the case studied. Performance assessment is based on a five-level scale coupled with a simple multi-criteria analysis (MCA) method. Three different applications (sludge valorisation, urban wastewater treatment, soil remediation) were carried out to validate the methodology, two of them are presented. Applications of this methodology show its usefulness in the validation of techniques for specific process and local application of the BAT concept and the performance assessment regarding BAT definition. It can then be used to detect innovative and emerging techniques to be proposed for the reviewing of the European BREF documents.

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1. Introduction

Developing or adapting new techniques to prevent pollution generation or impacts is the huge stake of the century. Due to global, regulatory and social constraints, these actions must be accompanied by environmental, social and technical assessment. Cleaner production strategies (UNEP, 2001) and the Industrial Emission European Directive (IED) with the concept of Best Available

Techniques (BAT) reflect this point of view (Laforest, 2008; Giner-Santonja et al., 2012). In fact, for the past 20 years, the European context has been policy-driven by several directives to reduce pollution; we can notice that two important ones for industries being the Integrated Pollution Prevention and Control (IPPC) directive abrogated by the IED and the framework directive on water (WFD). The IED's objective is to minimise pollution from various industrial sources throughout the European Union. One mean of attaining the objective is to implement techniques which have at least the same performance as reference techniques called BAT given at European level. This implementation is supported by an environmental permit which must be obtained before operating. This permit is driven by several obligations for example to conform to emission limit values based on BATAEL (Best Available Techniques Associated Emission Level) and to prove the implementation of, wherever possible, a technique having an equivalent performance as BAT. More than a "static" obligation, this permit must be revised periodically

Abbreviations: IED, industrial emission directive; BAT, best available techniques; BREF, best available techniques reference document; IPPC, integrated prevention pollution and control; WFD, water framework directive; BATAEL, BAT associated emission level; LCA, life cycle analysis; MCDA, multi-criteria decision analysis; COD, chemical oxygen demand; WWTP, wastewater treatment plant; MCA, multi-criteria analysis.

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to take into account changes in BAT conclusions. The assessment is based on a comparison between the plant's current performance and that which could be obtained with BAT.

The BAT concept was defined in the IPPC directive and is now integrated into the IED. The principle of BAT, as defined initially by the IPPC directive, has become a significant issue for industry: the implementation of this Directive actually compels companies to apply techniques which have the same performance as BAT. The BAT principle is defined as being "the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole" (Directive, 2008).

The terms "best", "available" and "techniques" are detailed as follows:

- 'Techniques' includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;
- 'available' techniques mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator, and
- 'best' means most effective in achieving a high general level of protection of the environment as a whole.

This definition is reinforced by the Annex III of the IED, which exposes 12 criteria to be taken into account for the determination of BAT. Unfortunately, this information does not seem to be sufficiently clear and useful for a proper environmental performance assessment of techniques seen as BAT (De Chefdebien, 2001; Laforest and Berthéas, 2004). This fact has been highlighted by a study aiming at assessing the degree of clarity of the consideration to be taken into account for BAT assessment in order to clarify them and thus improve their use.

With this end in view, a questionnaire was devised comprising two simple questions concerning the considerations and distributed to our sample population. Having listed the twelve considerations, we asked them: to put them in order of importance, to give definition criteria for each consideration.

The sample, composed of 40 people (industrialists, researchers, public or para-public institutions, technical centres and associations), answered the questionnaire are all deeply involved in environmental issues. The study carried out revealed a great number of redundancies and heterogeneity in the considerations contained in Annex III and then a difficulty to use them. A new definition of them is necessary for good take up and use (Laforest and Berthéas, 2004).

In order to support decision-makers (industrialists, authorities) in the choice, the assessment or the validation of techniques as BAT, IED requires the European Commission to organise an exchange of information concerning BAT between member states, NGO and the industries concerned (article 13 of the IED). Nevertheless, the directive does not impose the application of a specific technique. The EIPPCB (European IPPC Bureau) has the role of coordinating, planning the information exchange and assessing and validating the results of the exchange which are summarised in the BAT Reference documents called BREF (Bailly, 2001; Laforest, 2008). Two types of BREF exist: sectorial BREF considering sectors listed in the Annex 1 of the IED and horizontal BREF applicable to several sectors (EIPPCB, 2014). Moreover, it is possible to have several BREF for a sector (e.g. the chemical industry).

The techniques presented in each BREF as BAT are identified at the European level and for the industrial sector concerned as a whole (Schoenberger, 2011; Giner-Santonja et al., 2012). These techniques have proved their efficiency in preventing environmental impacts, and when this is not practicable, reducing emissions and the impact on the environment as a whole (article 3 of the IED). However for a local application, reference techniques in the BREF concerned could sometimes not be the relevant BAT. Other techniques can be assessed as BAT in terms of performance for a local application. Moreover, a BAT presented in a BREF could be relevant for one installation but less efficient for another of the same sector. Thus, BREFs developed for the industrial sector cannot represent each individual facility (Schoenberger, 2011).

Besides these definitions, it is necessary to consider that an emerging or innovative technique can be validated as a BAT for a specific and local application because of the local and specific conditions on implementation. In this line of thought, emerging and innovative techniques could be validated as BAT in specific cases for a local and specific application but not for a BREF because these techniques must have proven their efficiency.

With this idea in mind, we focused our research on the support of these new techniques. The objective was to propose a methodology to support the development of innovative and emerging techniques by comparing them to BAT given by the European process. IED defines emerging technique as "a novel technique for an industrial activity that, if commercially developed, could provide either a higher general level of protection of the environment or at least the same level of protection of the environment and higher cost savings than existing best available techniques". An innovative technique is a technique which presents a novelty and not directly available on the market.

This results in the possibility of comparing the innovation to BAT from BREF. For this comparison, BREF documents are useful knowing that a list of BAT is given for each unit of the production process.

Acronyms: IED, Industrial Emission Directive; BAT, Best Available Techniques; BREF, Best available techniques Reference document; IPPC, Integrated Prevention Pollution and Control; WFD, Water Framework Directive; BATAEL, BAT Associated Emission Level; LCA, Life Cycle Analysis; MCDA, Multi-Criteria Decision Analysis; COD, Chemical Oxygen Demand; WWTP, WasteWater Treatment Plant; MCA, Multi-Criteria Analysis.

2. Existing tools

Despite the existence of the Sevilla process and the need to justify the performance of techniques to be considered as BAT, no official methodologies are proposed and used by the European Commission. Nevertheless, several methodologies have been developed to determine BAT. The objectives of these methodologies are essentially:

- To assess industry performance as BAT for Integrated Environmental Authorisation (Krajnc et al., 2007; Cikankowitz, 2008; Giner-Santonja et al., 2012; Schollenberger et al., 2008; Ibáñez-Forés et al., 2013; Laforest and Berthéas, 2004; Laforest and Cikankowitz, 2006).
- To assess performance of techniques to validate them as BAT or to determine BATAEL (Dijkmans, 2000; Schultmann et al., 2001; Geldermann and Rentz, 2004; Georgopoulou et al., 2008; BREF ECM, 2006; Derden et al., 2002; Mavrotas et al., 2007; Polders et al., 2012; De Chefdebien, 2001; Nicholas et al., 2000; Bréchet and Michel, 2007; Bréchet et al., 2009; Zarkovic et al., 2011).

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