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Best Available Techniques: An integrated method for multicriteria assessment of reference installations

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Acronyms:

BAT
Best Available Technique
BREF
BAT Reference document
EPLI
Environmental Performance Level Indicator
HC
Hierarchical Clustering
IED
Industrial Emission Directive
EIPPCB
European IPPC Bureau
IPPC
Integrated Pollution Prevention and Control
KEI
Key Environmental Issue
NGO
Non-Governmental Organisation
PCA
Principal Component Analysis
TWG
Technical Working Group

ABSTRACT

The Industrial Emission Directive (IED) has strengthened the requirement to apply Best Available Techniques (BATs) first introduced by the IPPC Directive. The so-called “Sevilla Process”, which is the formal European process to define and revise BATs, is based upon an exchange of information among different stakeholders and relies on data analysis and expert judgements. If the process to collect and to share information between stakeholders at sectoral and installation levels is well defined, the determination of BATs and BAT-Associated Environmental Levels has evolved along with the revision of the BAT REFERENCE documents (BREFs). Nevertheless, no formal tool to support the analysis exists. The objective of this article is to present a 5-steps methodology aimed to classify installations according to two multicriteria approaches, either a representative angle or a performant approach, and then to identify reference installations, which would help to propose reference values and possible BATs. The methodology is supported by statistical tools (Principal Component analysis, hierarchical clustering) and algorithmic approach (MissForest). The application to French dairy sectors has validated the methodology and mathematical tools used. Two reference classes has been identified for the representative approach and 19 installations selected. For the performant installations, seven (7) installations has been selected. BATAELs for COD flow are proposed considering these classifications and an effort rate comprised between 23 and 96% has been revealed.

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1. Introduction

The concept of Best Available Technique (BAT) was initially defined in the IPPC directive (Integrated Pollution Prevention and

Control – 1996/61/CE) and has been included in the IED (Industrial Emission Directive – 2010/75/EU) as “*the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole*” (European Commission, 1996). The concerned industries

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must therefore demonstrate that they reach environmental performance associated with BATs.

In order to determine sectoral BATs in the framework of the IED and to publish reference documents called BREFs, a decision process has been formalized in an implementing decision (European Commission, 2012). The so-called Sevilla Process consists in an information exchange (Fig. 1) among actors at different geographical scales. At European level, a Technical Working Group (TWG) consisting of experts from the member States, the Industry and environmental NGOs collects and processes data coming from the local level, i.e. from site operators. This step can be undergone through a national shadow group formed from the local authorities and industries. The data are then compiled by the European IPPC Bureau (EIPPCB) which coordinates the exchange and the discussion. The goal is to publish a reference document about sectoral BATs (BREF) which will be used by local authorities and industries to comply with the directive.

In particular, environmental performances of operating installations and their implemented techniques are assessed according to “key environmental issues” (KEI) that are meant to be minimized by BATs. These KEI are usually substances consumed or emitted and depend on environmental stake defined by consensus between experts during preliminary steps of Sevilla process for each industrial sector. They are used to target a sample of reference installations, whose characteristics and specificities are deemed relevant and representative from the sector (e.g. direct or indirect wastewater discharge; main production ...). Therefore, technical experts are said to know what kind of installations or processes are representative of the sector. However, differences of interpretation of the kind of installations to be used exist. Indeed, depending of the actor, the definition of reference installations can vary among best performers, representative of the main production or emission characteristics, or simply average installations; without any clear or official definition. This choice may impact the economics of installations and their environmental performances, depending on costs to implement BATs (Begak et al., 2015; Daddi et al., 2014). In consequences, since 2000s several methodologies have been

developed at different scales.

In their literature review concerning best available technique assessment methods from sector to installation level, Evrard et al. (2016) showed that BAT determination has been the subject of several researches to assess technique performances compared to BATs from reference documents or to support the determination and the application of BATs. Eighteen methodologies had been studied considering: (1) the industrial sector level, the installation level or both level (2) quantitative or qualitative assessment (3) the area of application (4) the end-users and (5) the step-number.

At the industrial sector level, seven methodologies had been identified. Among them, Dijkmans, (2000), Derden et al. (2002), Polders et al. (2012) and Derden and Huybrechts (2013), from the same Flemish institute propose qualitative approaches. Moreover, two articles (Nicholas et al., 2000; Halog et al., 2001) concerned the comparison of candidate BATs for an industrial sector without geographical considerations. Finally, Schollenberger et al. (2008) focused on commenting the Sevilla Process with a view to adapting BATs outside the EU (Evrard et al., 2016).

At the installation level, three main objectives have been identified in the literature review: firstly, performance evaluation according to local conditions (Kabak et al., 2014; Laforest, 2014), secondly, comparison between installation and BATs (Barros et al., 2009; Cikankowitz and Laforest, 2013) and thirdly BATs selection (Bréchet and Tulkens, 2009; Rodríguez et al., 2011; Giner-Santonja et al., 2012; Bortolini et al., 2013; Ibáñez-Forés et al., 2013; Aloini et al., 2014; Nguyen et al., 2014). Moreover, Van Caneghem et al. (2010) proposed a regional method considering the relations between environmental and economic performances. Most of these articles dealt with quantitative assessment except for Cikankowitz and Laforest (2013) (Evrard et al., 2016).

Moreover, literature review has putted forward the fact that a seven-step methodology is needed for the determination and application of BAT (Fig. 2). Considering the existing propositions, none of the methodologies presented in the literature review articles covered all the steps need.

In fact, despite the numerous of methodologies developed, the entire Sevilla Process and its multi-scale approach has not been fully covered by any existing methods (Cikankowitz and Laforest, 2013; Laforest and Gaucher, 2015); in particular no existing method considers simultaneously every KEI, nor state a clear definition of what reference installations are. However, several steps seemed essential to the determination of BATs, considering their application at several geographic scales (European, national, local) and reference installations definition.

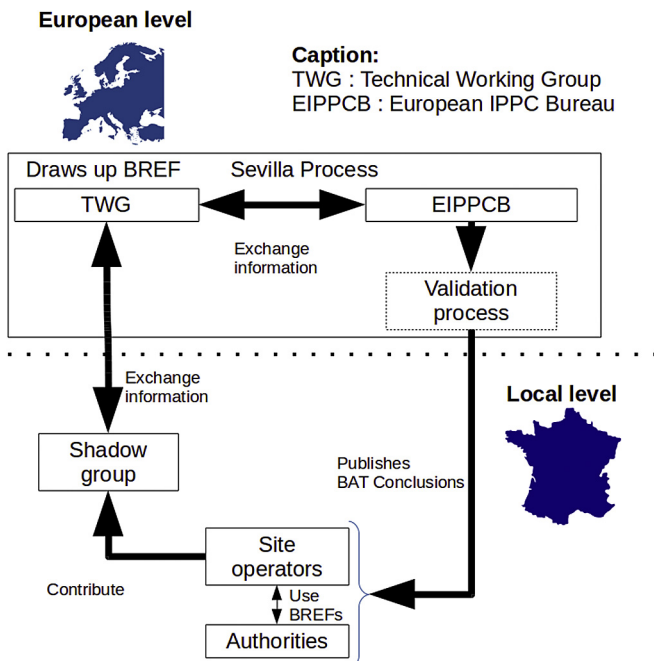


Fig. 1. Information exchange during the Sevilla Process.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Industrial sector level	1																		
	2																		
	3																		
Installation level	4																		
	5																		
	6																		

Caption of the articles:

1. Dijkmans (2000); Derden et al. (2002); Polders et al. (2012); Derden and Huybrechts (2013)
2. Geldermann and Rentz (2004)
3. National Observatory of Athens (2006); Mavrotas et al. (2007); Georgopoulou et al. (2008)
4. Nicholas et al. (2000)
5. Halog et al. (2001)
6. Schollenberger et al. (2008)
7. Barros et al. (2009)
8. Cikankowitz and Laforest, 2013
9. Giner-Santonja et al. (2012)
10. Bréchet and Tulkens (2009)
11. Rodriguez et al. (2011)
12. Bortolini et al. (2013)
13. Ibáñez-Forés et al. (2013)
14. Aloini et al. (2014)
15. Nguyen et al. (2014)
16. Van Caneghem et al. (2010)
17. Kabak et al. (2014); Laforest (2014)
18. Ibáñez-Forés et al. (2013)

Fig. 2. Aggregated steps for the determination and application of Best Available Techniques (Evrard et al., 2016).

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