



Review

Overview of extraction, clean-up and detection techniques for the determination of organic pollutants in sewage sludge: A review

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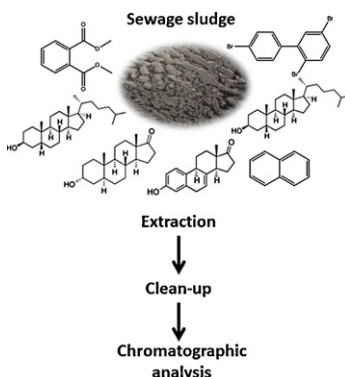
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HIGHLIGHTS

- ▶ A peer-review literature on the analysis of organics in sludge is presented.
- ▶ Both priority and emerging pollutants were detected in sludge samples.
- ▶ Current state-of-the-art is discussed involving extraction, clean-up and analysis.
- ▶ Classical techniques represent high percentages of the papers of organics in sludge.
- ▶ PLE represents more than a half of the total manuscripts using novel techniques.

GRAPHICAL ABSTRACT



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ABSTRACT

Priority pollutants constitute only a part of the large chemical pollution puzzle where the number of potentially hazardous chemicals that reaches the environment is very wide and new substances are constantly being developed and released. Among them, a diverse group of unregulated pollutants, many times called “emerging” contaminants, including pharmaceuticals and personal care products (PPCPs), is found. This group of emerging contaminants constitutes a broad class of chemicals widely used in daily life, such as synthetic fragrances, UV filters, antiseptics, antioxidants and insect repellents. The large amount of them and other emerging contaminants consumed in modern society contribute as well to a wide range of contamination in the aquatic environment, introduced mainly through wastewater treatment plants (WWTPs). The agricultural application of sewage sludge has become the most widespread method for its disposal, since it is the most economical outlet for sludge and offers the opportunity to recycle plant nutrients and organic matter to soil for crop production. However, due to the presence of metals, organic contaminants and pathogenic bacteria in sewage sludge, concern has increased about the human exposure to priority and emerging pollutants via crops cultivated in sewage/compost-amended soils. Because of the potentially dangerous consequences of the presence of those contaminants in the

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environment, data concerning the concentration, fate and behavior of those pollutants is urgently necessary. With this purpose in mind, sensitive and robust analytical methods for complex matrices such as sewage sludge are necessary in order to obtain reliable data that help us to understand the risk of agricultural use of sewage sludge. The present manuscript reviews the different approaches present in the literature for determining organic pollutants (priority and emerging) in sewage sludge. A review of the last ten years has been performed and the three main steps of an analytical procedure (extraction, clean-up and analysis) have been reviewed.

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