The Role of End of Waste Criteria in the Framework of Circular Economy Strategy.

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Abstract. More than 1.8 billion tonnes of waste are produced each year in Europe. This equals to 3.5 t per person and are mainly produced from commercial activities (e.g. shops, hospitals, restaurants), industry (e.g. clothes manufacturers, pharmaceutical companies), agriculture (e.g. slurry), construction and demolition projects, mining and quarrying activities from energy production as well as from household activities.Article 6 in WFD (2008/98) defines that those wastes must be reduced as well as contain provisions to define end-of-waste criteria (EWC) that provide a high level of environmental protection and an economic benefit. Qualifications and requirements should be established in agreement with certain conditions described in the directive to check if specific waste streams have reached an end-of-waste (EoW) status. The main goal of EWC is to remove and eliminate the administrative loads of waste legislation for safe and high-quality waste materials, thereby facilitating and assisting recycling. The target is to produce effective with high quality of recyclables materials, promoting product standardisation and quality and safety assurance, and improving harmonisation and legal certainty in the recyclable material markets. EWC could be useful toll in the framework of circular economy strategy as affect several management systems, industrial processing, clean technologies. The presentation will analysis the role of EWC in the framework of Circular Economy through several case studies such as Tire Pyrolysis Oil, Compost etc

Keywords: circular economy, bench marking indicators, end of waste criteria, quality protocols, LCA.

1. Introduction

Today more than ever, the European Commission is working hard to preserve our limited resources as well as it is well known that waste, is mainly considered an environmental issue although it has a strong relation with social dimensions and economics. Having in mind the concept of Circular Economy (Loizia et al., 2018; Zorpas, 2020) it is very attractive and at the same time challenged secondary materials to be used either for energy production, soil fertilizer, extraction of high added value products aiming to reach the targets set in the 7th EAP as well as to reduced CO_2 emissions. Despite the quantities of waste, that are being produced per economy sector; in order to be able to re-introduced those secondary materials in the production line as raw material, then they must meet specific requirements as well as must have specific quality protocol. EWC criteria do not intend to address decisions concerning strategic waste management options. The objective is to define technical criteria for determining when a waste ceases to be a waste, without risking the environment. EWC are a tool to help improve recycling by determining when a waste ceases to be a waste, independently from the waste management option chosen. Moreover, do not exclude materials from being recycled. If a material does not meet the EoW requirements, this does not imply that the material cannot be recycled and needs to be disposed. Materials not fulfilling the EoW requirements can be recycled and reused under the waste rules. EWC will not be applicable to all wastes but only to specific waste streams for which EWC can be developed, agreed and adopted within the provisions of the WFD (Zorpas, 2015).

2. Material and Methods

Figure 1 presents the concept aproach of how to declacified Tire Pyrolisis Oil (TPO) traking into account the 4 major stpes that included in WFD. Fıgure 2 indiacted how EWC are bieing developed. The whole process is dealing with the declasification of Tire Pyrolis Oil (TPO) which is produced from End of Life Titres (ELTs) and aim to replace LFO (Ligth Fuel oil).

3. Results and Discussions

According to Symeonides et al., (2019) as a general rule: for each new tire that entering the market one tire has reached its end of life.In EU level on 2013 was estimated that the used tires were more than 3.6 million t, on which 2.7 million t had been recovered and recycled with the average weight to be equal with 9 Kg for cars and 45 Kg for lorries (Antonis and Zorpas,

2019). Pyrolysis is considered as valuable solution to treat ELTs in order to produced carbon black and TPO. However, TPOischaracterized as an extremely complex mixture of organic compounds (5 to 37 carbons) plus aromatics. TPO has a great potential to replace LFO although presents unique calorific value but at the same time the presence of contaminants like chlorine, sulphur and nitrogen, heavy metals make the potential use of it problematic. Through the steps in Figure 1 and 2 as well as the proposed methodology as indicated by Antoniou and Zorpas (2019) the TPO must have the following characteristics as those are presented in Table 1.

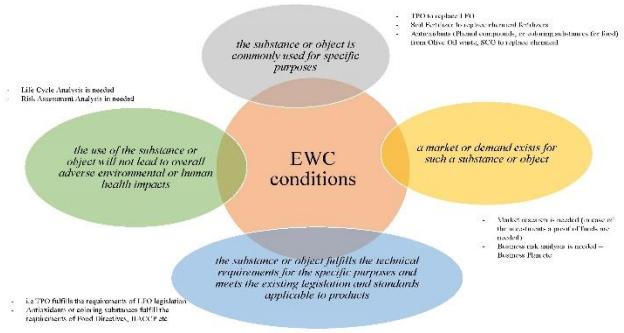

Figure 1. main steps and requirement for EWC

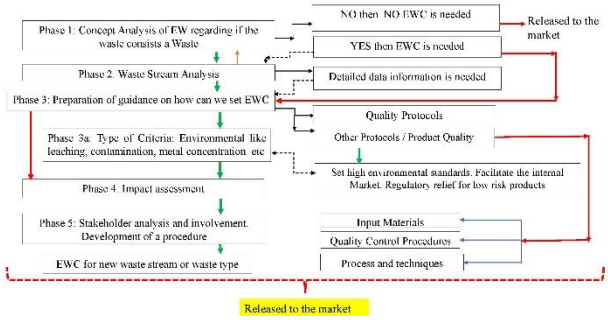

Figure 2. How EWC are developed

Table 1: EWC for TPO

Parameter	Units	Limits		Proposed Test and Method or other equivalences	
		Min	Max		
Density 15° C	kg/m³		980.0	CYSENISO 3675 CYSENISO 12185	D 1298/IP 160
Viscosity 50°C **Winter** **Summer**	cSt	 30.0 50.0	 55.0 80.0	CYSENISO 3104	D 445/IP 71
Pour point **Winter** **Summer**	°C		 0 15	ISO 3016	 D 97/IP 15
Sulphur	%(m/m)		1.0	CYSENISO 8754 CYSENISO 14596	D 4294/IP 336
Flash Point	°C	60	-	CYSENISO 2719	D 93/IP 34
Ash	%(m/m)	-	0.15	CYSENISO 6245	D 482/IP 4
Water	%(V/V)		0.75	ISO 3733	D 95/IP 74
Sediment	%(m/m)		0.15	CYSENISO 3735 ISO 10307-1	D 473/IP 53
Acidity: Inorganic	mgKOH/g	Zero		ISO 6618	D 974/IP 139
Calorific Value, highest	**MJ/kg**	To be defined (sug.>35MJ/kg)		**ISO 8217**	
Total Halogen (as chloride) (max)	mg/kg		5		IP 503
PCB's (max)	mg/kg		5		IP 462

The LCA approach (Fig. 3 and 4) indicated that the use of the substance or object will not lead to overall adverse environmental or human health impacts

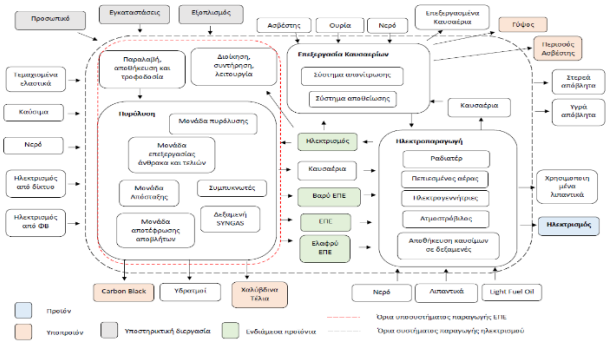

Figure 3. LCA systems Boundaries

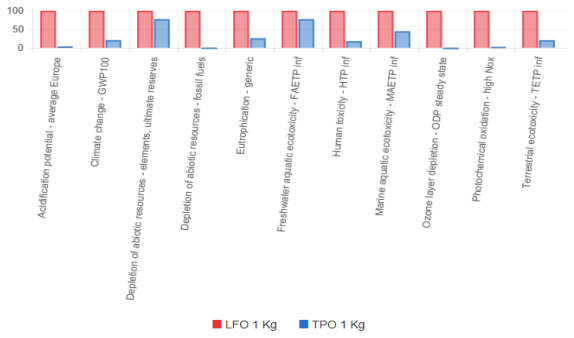

Figure 4. LCA for TPO in relation with LFO

4. Conclusions

This research indicated the importsnce of EWC in the case of TPO as TPO can be used to replace LFO. The proposed criteria as well as the results from LCA provide useful information on how TPO can be use with out affecting the environment

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