Leaching study based on metal and anion release according to the composition of CDW

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INTRODUCTION

Currently, new alternatives that are technically and environmentally viable for waste revaluation are being explored at different levels. The recycling of by-products or waste to give them a second life cycle as construction material requires: technical feasibility studies, environmental evaluation of the material, application of regulations at different scales and implementation of a production system that produces a quality material.

This study focuses on the leaching environmental study of construction and demolition waste (CDW) through leaching tests that measure the release of legally regulated polluting elements.

The objective is to characterize the potential contamination of each of the components of the CDW. To develop this study, a treatment plant has been visited and samples of different components of this waste have been taken (mortar, concrete, tile, ceramic brick, or asphalt).

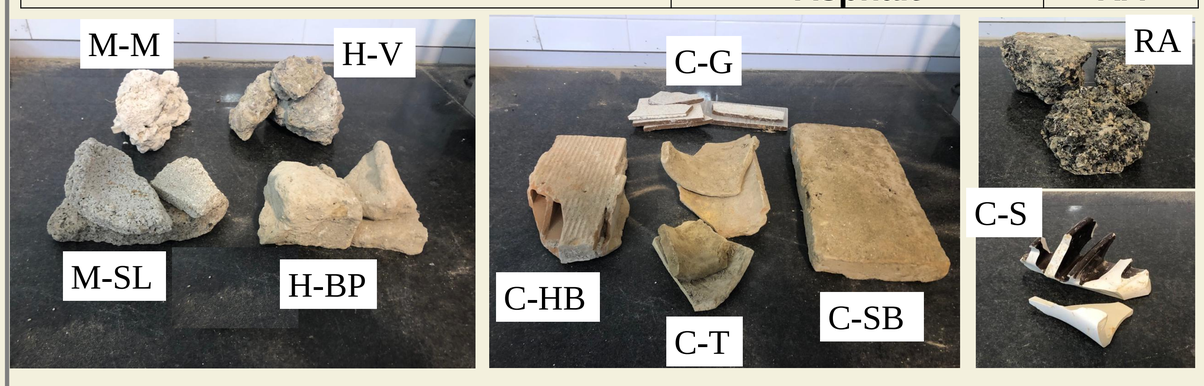
The analysis focuses on measuring the release of pollutants from each of these components. In this way, it is possible to identify which components are environmentally more sensitive and will allow optimizing decision-making in CD&W treatment plants.

MATERIALS

The present work studies the pollutant release on different CDW components tested separately. The samples has been collected from a treatment plant located in Córdoba (Andalusia, Spain) consisting of the components, with their codes, described in Table 1 and Figure 1.

Table 1: Descriptions and codes for each of the components collected

Description	Code	Description	Code
Single layer mortar	**M-SL**	**Ceramic tile**	**C-T**
Masonry mortar	**M-M**	**Ceramic stoneware**	**C-G**
Old concrete	**H-V**	**Ceramic Solid brick**	**C-SB**
Precast concrete block	**H-BP**	**Sanitary Ceramic**	**C-S**
Reinforced precast concrete	**H-PP**	**Ceramic Hollow Brick**	**C-HB**
		Asphalt	**RA**



EXPERIMENTAL METHODS

This research is focused on the study of the pollutant release of the list of elements indicated by EU Landfill Directive (EC, 2003): 12 heavy metals and 3 anions measured on leachates obtained according to the Compliance Batch Test (UNE-EN 12457-4: 2003) (Figure 1) . This leaching procedure establishes a liquid to solid ratio of 10 l/kg using 90 g of dry material samples with particles sizes less than 10.0 mm and deionized water. The solution was kept under mechanical agitation per 24 ± 0.5 h. After each extraction, the sample leachate was analyzed for measuring heavy metals content by ICP-MS and anions by chromatograph, in order to obtain the release for each sample.

Figure 1: From the left to right; Images of each of the component and their codes; Collection of the samples in the CD&W treatment plant; Compliance leaching test

RESULTS & DISCUSSION

The data obtained for the 11 different components of CDW tested separately will be compared with the legal limit established by the Landfill Directive (Table 2). The objective is identifying the pollutant elements released in higher amount by each type of component on CDW. The following compounds did not surpass the inert limit: M-SL, H-V, H-BP, H-PP,. C-T, C-G, M-M, C-S and RA, whereas it was exceeded due to Cr and sulphate for M-M and due to Cr for C-HB, the usual most conflictive ones (Figure 2) and due to Cl^- for C-SB.

Release (mg/kg)	M-SL	M-M	H-V	H-BP	H-PP	C-HB	C-T	C-G	C-SB	C-S	RA
Cr	0.12091	**0.75134**	0.06311	0.27293	0.12922	**1.06427**	0.04832	0.02524	0.14657	0.00535	0.01323
Ni	0.00836	0.0041	n.d.	n.d.	0	0.00223	0.00982	0.01053	0.01179	0.00774	n.d.
Cu	0.00467	0.03002	0.03088	0.00976	0.00395	0.01222	0.0443	0.0144	0.01436	0.01087	0.01857
Zn	0.03522	0.03578	0.03127	0.03898	0.02936	0.02921	0.04236	0.1637	0.0478	0.05712	0.03578
As	0.00075	0.03519	0.0082	0.00069	0.00186	0.03221	0.03537	0.05075	0.0252	0.00434	0.00151
Se	n.d.	0.00844	n.d.	n.d.	0.00016	0.00376	0.0054	n.d.	0.01446	n.d.	0.00024
Mo	0.04477	0.06638	0.0313	0.18891	0.00974	0.05388	0.04211	0.00746	0.02697	0.00942	0.00799
Cd	n.d.	0.00006	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.00044	0.00029	0
Sb	0.0036	0.01297	0.0249	0.02314	0.00233	0.02095	0.01624	0.02017	0.01059	0.0053	0.0045
Ba	1.51804	0.44925	0.4188	0.3195	1.81608	0.03383	0.28966	0.09343	1.32473	0.04525	3.76029
Hg	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Pb	0.00039	0.00008	0.00086	0.00116	0.00048	0	0	0.01809	0.00038	0.00137	0.00029
$SO_4^=$	<20	**1850**	350	220	<20	860	670	40	150	<20	110
Cl-	<20	40	40	50	30	220	320	50	**1220**	<20	50
F-	< 2	3	3	< 2	< 2	< 2	12	3	< 2	< 2	< 2
Cond (mS/cm)	3200	494	866	1322	3130	445	454	101	3500	41	156
pH 20 ºC	10	6.7	10	10	10	8	6.7	7.8	6	5.6	10

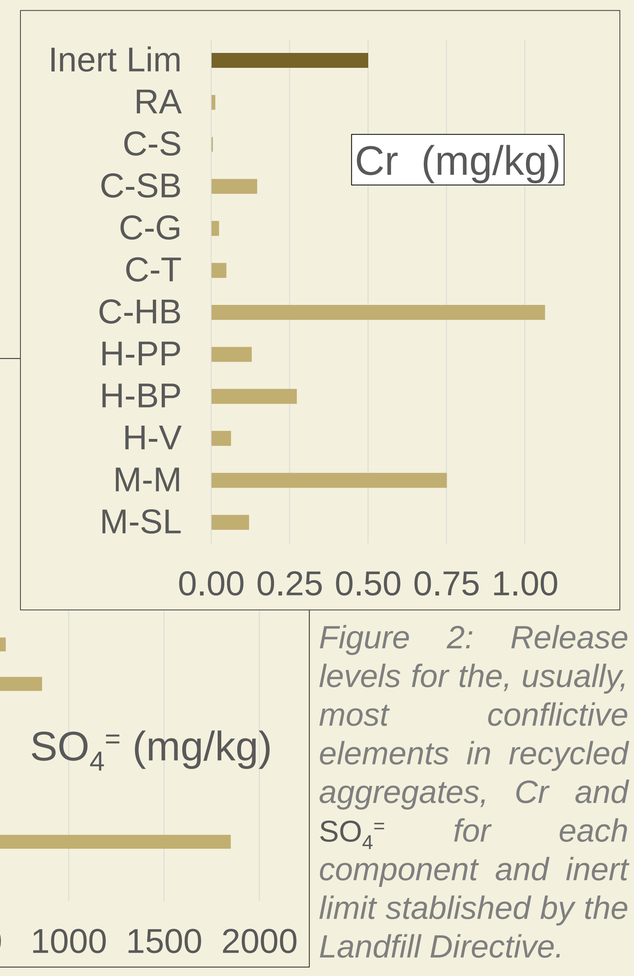


Figure 2: Release levels for the, usually, most conflictive elements in recycled aggregates, Cr and $SO_4^=$ for each component and inert limit stablished by the Landfill Directive.

Table 2: Leachate in mg/kg by compliance leaching test

CONCLUSIONS

CDW treatment plants handle every day different CDW from different sources. Knowing the potential release of each of the components of CDW can be an important information for determining the operations within the CDW treatment plant; for instance, the stockpiling according to the presence of the components with higher potential of releasing pollutant elements or, during the feeding, with the loader, of the process treatment for obtaining recycled aggregates, compensating the CDW depending on the components for avoiding excessive presence of components with higher potential of releasing pollutant elements. For instance, the results leads to the idea that masonry mortar could be a component to bear in mind for the aforementioned reasons.