



# Environmental criteria related to End of Waste legal framework for Recycled Aggregates from CDW

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## 1 INTRODUCTION

Leaching tests have proven to be an indispensable tool to evaluate the contaminant release from recycled aggregates (RA) as new construction materials. Leaching procedures simulate the rain effect exposure on any type of material used in infrastructure: earthwork fillings, fill for drainage structures, road subbases, or embankments. Hence, the prediction of polluting potential is possible by performing different leaching procedures at the laboratory scale. Europe currently lacks a unified legal framework for the materials under study, specifically RA from Construction and Demolition Waste (CDW), whose production reached 800 million tonnes in 2020 [1].

The 2008 European Waste Framework Directive set a target of 70% CDW recovery by 2020 and also included a provision to establish the 'End of Waste' (EoW) criteria at the EU level. Currently, the Netherlands recycles 100% of their waste, but other countries such as Italy or Spain aim to increase their recycling rate (Eurostat, 2020). This study also compares the effect of different test procedures (UNE-EN 12457-4 and UNE-EN 12457-2) which are applied in the majority of European Member States in the EoW criteria. In the present study, data from Spain and Italy were compared to evaluate the effect of RA from CDW release on heavy metals and anions listed by the EoW.

## 2 MATERIAL AND TEST METHODS

The compliance leaching tests that are the most used are standards EN 12457-2 and EN 12457-4 across Europe. In particular, part -2 is adopted in Italy, while part -4 is used in Spain. 9 RA were tested: 2 MRA (Mixed Recycled Aggregate), 2 RCA (Recycled Concrete Aggregate), 2 RS (Recycled Soil), 2 RF (Recycled Fine Fraction), and 1 RG (Recycled Gravel). Table 1 shows the limits imposed by Italy for determining the EoW and the limits adopted in Spain so far, where the EoW criteria are still unclear.

Standard	(L/S)	Grain size
UNI-EN 12457-2	10 L/kg	< 4 mm
UNE-EN 12457-4	10 L/kg	< 10 mm



Table 1. Leaching test adopted for environmental compliance; Italy and Spain.

\* In Spain, in case that the sulphate limit is surpassed the 1<sup>st</sup> eluate (L/S=0.1) of the percolation test (EN14405) must be below 1500 mg/l and the compliance test must be below 6000 mg/kg.

	Sb	As	Ba	Cd	Cr	Co	Cu	Hg	Pb	Mo	Ni	Se	Sn	V	Zn	Cl <sup>-</sup>	F <sup>-</sup>	SO <sub>4</sub> <sup>=</sup>		
ITALY	EN 12457-2	mg/kg	-	0.5	10	0.05	0.5	-	0.5	0.01	0.5	-	0.1	0.1	-	2.5	30	7500	15	7500
SPAIN	EN 12457-4	mg/kg	0.06	0.5	20	0.04	0.5	-	2	0.01	0.5	0.5	0.4	0.1	-	-	4	800	10	1000*

## 3 RESULTS AND DISCUSSION

Fig. 1 shows the most common conflictive element, Cr, and the Chloride (Cl<sup>-</sup>) and Sulphate (SO<sub>4</sub><sup>=</sup>) anions [2] for the EN 12457 standards. For Cr, the average detriment for UNE 12457-2 compared to part 4 was -16%; for Cl<sup>-</sup> and for the SO<sub>4</sub><sup>=</sup> anion, it was -0.6% and 4.7%, respectively. There was a strong correlation between part 4 and part 2 (R<sup>2</sup>>0.7). The SO<sub>4</sub><sup>=</sup> limit was the only one surpassed, just by the Spanish inert limit of 1000 mg/kg for several RA, while only RS1 was above the upper limit of 6000 mg/kg; no sample was above the Italian inert limit.

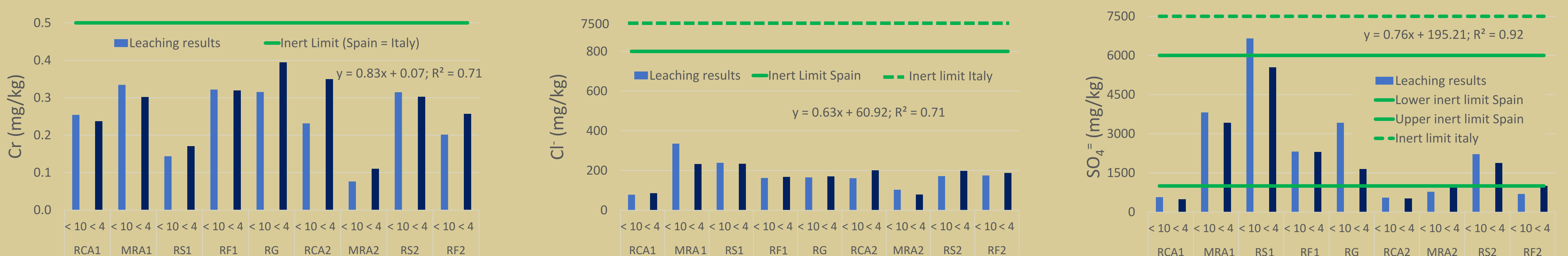


Fig 1. Leaching results for the Cr, and Chloride and Sulphate anions for the UNE 12457-2 and -4, along with the limits imposed by Italy and Spain

## 4 CONCLUSIONS

In light of the results obtained, this work explores the possibility of increasing the limit on sulphate anion content in the Spanish regulations, setting a maximum value of 6000 mg/kg without the need to compare with the percolation test, given that in Italy the limits are higher and there is little difference between the results of the standards.

## 5 References

- [1] Eurostat (2020). Eurostat statistics for waste flow generation.  
 [2] López-Uceda, A., Galvín, A. P., Ayuso, J., Jiménez, J. R., Vanwalleghem, T., & Peña, A. (2018). Risk assessment by percolation leaching tests of extensive green roofs with fine fraction of mixed recycled aggregates from construction and demolition waste. *Environmental Science and Pollution Research*, 25, 36024-36034.



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