UNIVERSITÀ DEGLI STUDI DI BRESCIA

CHANIA 2023

UNIVERSIDAD DE CÓRDOBA

CHARACTERIZATION OF AGGREGATES FROM CONSTRUCTION AND DEMOLITION WASTE IN RELATION TO ITALIAN AND SPANISH REGULATIONS

A. Piccinali, A. Abbà, A. P. Galvin, G. Plizzari, S. Sorlini

Speaker: Andrea Piccinali

a.piccinali@unibs.it

10th International Conference On Sustainable Solid Waste Management

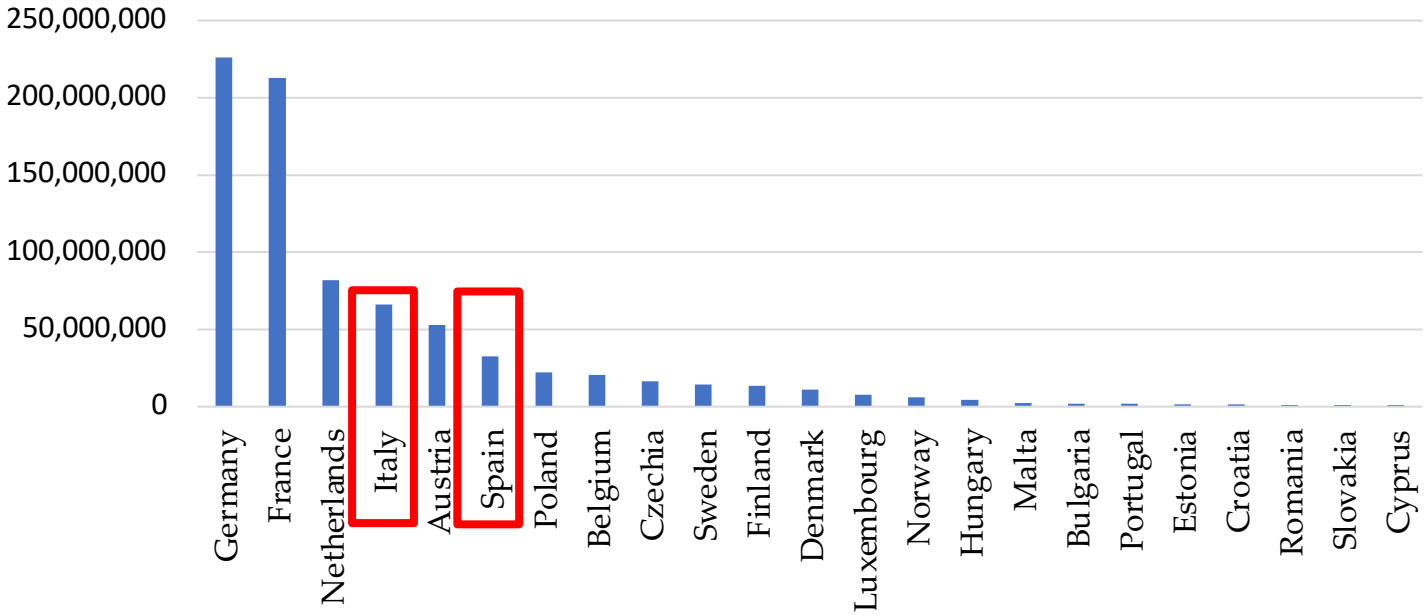
21-24 June 2023, Chania, Crete, Greece

CONSTRUCTION WASTE AND DEMOLITION PRODUCTION IN THE EU

At European level:

2.5 billion tons of special waste produced

800 million tons of construction and demolition waste



Eurostat (2023)

CONSTRUCTION WASTE AND DEMOLITION PRODUCTION IN ITALY AND SPAIN

In 2020 : 146.9 million tons of special waste (93% are non hazardous)

Italy: 64.8 million tonnes of CDW (over 45% of special waste)

Recovery: about 78% of the total produced

In 2020: 14.9 million tons of CDW waste in Lombardy

Spain: 32 million tonnes of CDW (about 55% of all the produced waste)

Recovery: about 42% of the total produced

In 2020 : 4 million tons of CDW waste in Andalusia

Source: Italy – Ispra (2022), Spain - Celex (2022)

THE ORIGIN OF RECYCLED AGGREGATES

NATURAL AGGREGATE (AN)

From natural deposits or from the crushing of rocks

RECYCLED AGGREGATE (AR)

From CONSTRUCTION WASTE and DEMOLITION (C&D) recovery processes

EWC CATALOGUE – Chapter 17 "Waste from construction and demolition activities"

EWC	DESCRIPTION
17 01	Cement, bricks, tiles and ceramics
17 02	Wood, glass and plastic
17 03	Bituminous mixtures and coal tar
17 04	Metals (including their alloys)
17 05	Earth (including soil from contaminated sites), rocks and dredging sludge
17 06	Insulating materials and building materials containing asbestos
17 08	Gypsum-based building materials
17 09	Other waste from construction and demolition
17 09 04	**Mixed waste from construction and demolition**

HETEROGENEITY of the material

Components	Europe	Italy	Spain
	% min-max	%	%
Concrete and walls:	40-84	80	66
• Concrete	12-40	30	12
• Walls	8-54	50	54
Gypsum	0,2-0,4	N.A.	0,2
Asphalt	4-26	5	5
Wood	2-4	2,5	4
Plastic	0,1-2		1,5
Metals	0,2-4	3	2,5
Mixed C&D waste	2-36	3,5	11,8
Excavated soil and rocks	N.A.	6	9

Source: Gálvez-Martos et al (2018), Zaia, De Berti (2019), Rodríguez-Robles et al. (2015)

D.M. 05/02/98 and M.D. 186/06 : Simplified procedures for NON-HAZARDOUS waste

Defines that RA obtained must not present hazardous characteristics higher to those of products and materials obtained from the processing of virgin raw materials.

For DIRECT RECOVERY Ministerial Decree 186/2006 **impose limits that leaching test on RA for certain polluting compounds must comply**

M.D. 152/22 – End of Waste Criteria for inert Waste

Entered into force on November 4, 2022, it was supposed to implement CDW waste recovery

Defines the compliance criteria for the purpose of **end-of-waste status**

Specific analyses introduced on **recycled aggregates.**

Royal Decree 105/2008

Is the regulation that affects all management operations of CDW.
It regulates:
(1) obligations of the C&D waste producers,
(2) recovery activities of these wastes in treatment plants
(3) regulation of the C&D waste disposal in landfill
(4) operations for the use of inert waste in restoration or filling works.

Real Decreto 646/2020

Regulates waste disposal in landfills.
Aims to contribute to the fulfillment of Sustainable Development Goals.
It is the only national legislation which includes limit values to be controlled in leachates.
Despite this regulation is focused on disposal of waste in landfill, **is the only reference to classify the polluting potential of RA from CDW.**

ENVIRONMENTAL COMPATIBILITY

For the assessment of environmental compatibility, the release tests carried out are different:

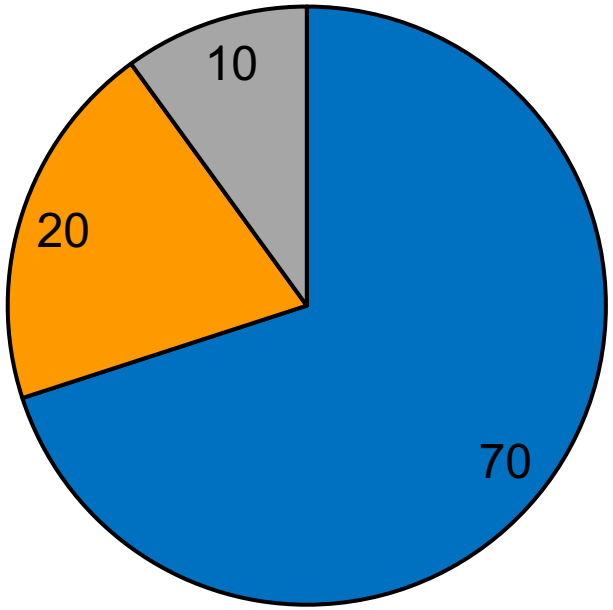
Parameter	UNI EN 12457-2:2004	UNE EN 12457-4:2004
Maximum size (Dmax)	4 mm	10 mm
Leaching agent	Demineralized water	Demineralized water
Liquid to solid ratio (L/s)	10 L/kg	10 L/kg
Duration	24 h	24 h
Number of extractions	1	1

MATERIALS: ANALYSIS OF COLLECTED DATA

ITALY

21 samples

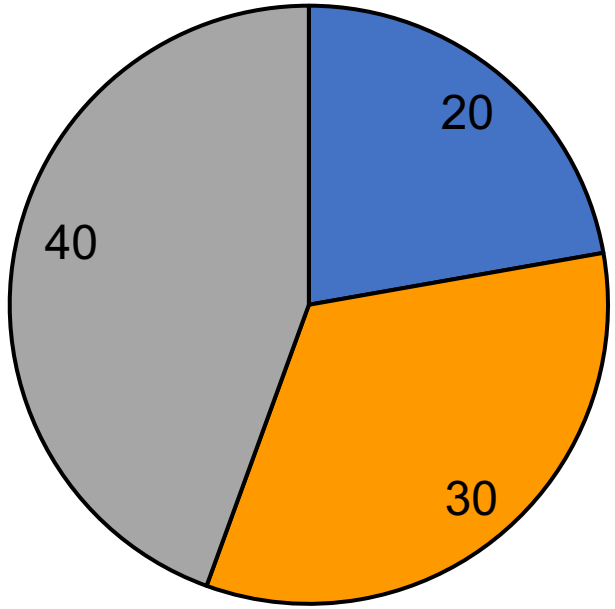
% origin of construction waste from which are obtained



SPAIN

21 samples

% origin of construction waste from which are obtained



EWC	DESCRIPTION
17 01	Cement, bricks, tiles and ceramics
17 05 04	Earth, soil and rocks
17 09 04	**Mixed waste from construction and demolition**

EWC 170904 EWC 170504 EWC 1701

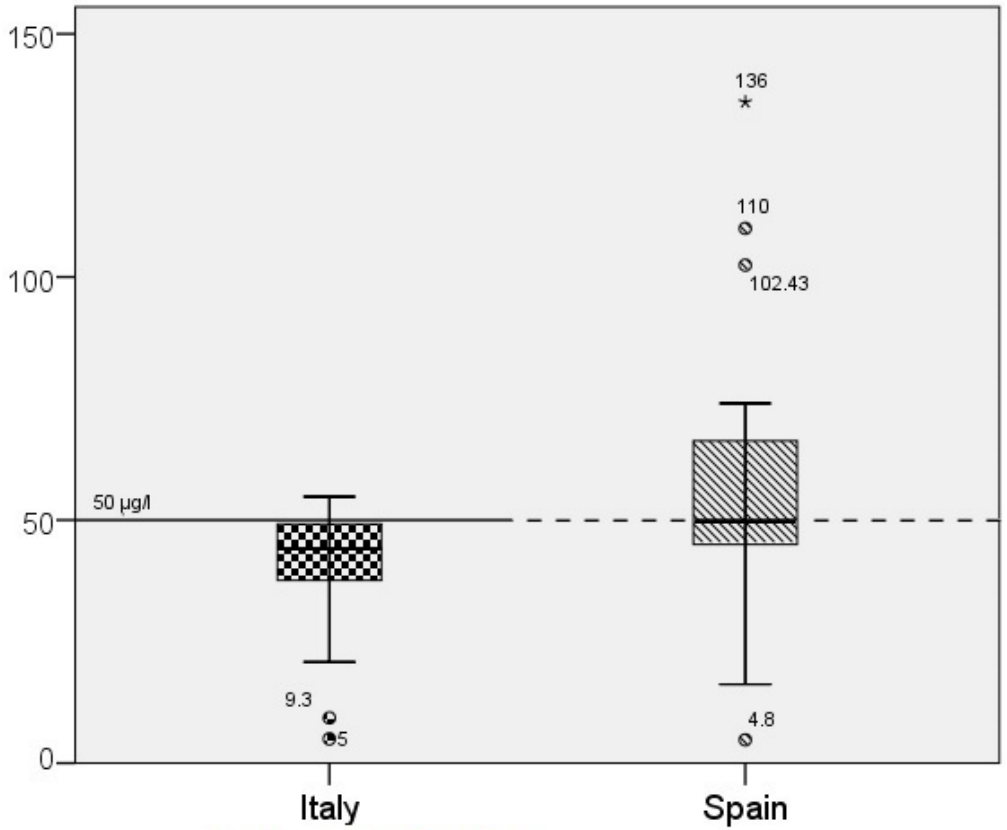
LEACHING TEST RESULTS ON RECYCLED AGGREGATE

		ITALY					SPAIN			
		Limit M.D. 186/2006	Limit M.D. 152/2022	Minimum Value	Maximum Value	Exceedance %	Limit R.D. 646/2020	Minimum Value	Maximum Value	Exceedance %
						%				%
pH	**-**	5.5 – 12	5.5 – 12	8.74	11.32	0	-	7.10	12.5	0
Fluoride	**mg/L**	1.5	1.5	0.1	1.02	0	1	<1	<1	0
Sulphate	**mg/L**	250	**750**	25	242.7	0	100	**5**	**575**	**48%**
Chloride	**mg/L**	100	**750**	<10	17.7	0	80	3	26,25	0
Barium	**mg/L**	1	1	<0.1	0.47	0	2	0,006	0,239	0
Copper	**mg/L**	0.05	0.05	<0.01	0.1	**10%**	0.2	<D.L.	0,03	0
Zinc	**mg/L**	3	3	<0.1	<0.1	0	0.4	<D.L.	0,017	0
Nickel	**µg/L**	10	10	1	9	0	40	0,06	14	0
Arsenic	**µg/L**	50	50	<5	19.1	0	50	<D.L.	2	0
Cadmium	**µg/L**	5	5	0.5	0.5	0	4	<D.L.	<D.L.	0
Total Chromium	**µg/L**	50	50	<5	54.8	**5%**	**50**	**4,8**	**136**	**43%**
Lead	**µg/L**	50	50	<5	11.1	0	50	<D.L.	2	0
Selenium	**µg/L**	10	10	**1**	**14.2**	**5%**	10	0,22	8,7	0
Mercury	**µg/L**	1	1	<0.5	5	**10%**	1	<D.L.	1	0
COD	**mg/L**	30	30	14.3	29.7	0	50	n.a.	n.a.	n.a.

Other parameters analyzed: Nitrate, Cyanide, Beryllium, Cobalt Vanadium, Molybdenum, Antimony, in which it was not possible to make a comparison given the fact that in one of the two states the limits were not present and therefore were not analyzed

DATA ANALYSIS – LEACHING TEST ON AR

TOTAL CHROMIUM

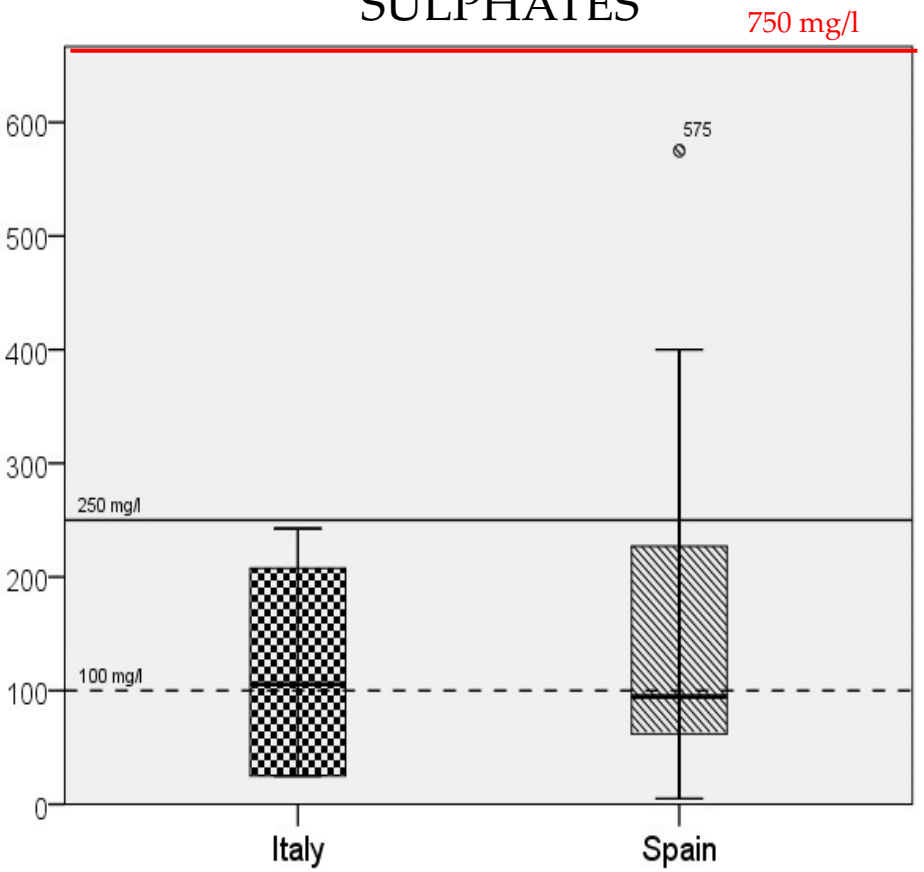


Italian M.D. 186/06

Spanish R.D. 646/20

Italian EoW M.D. 152/22

SULPHATES



The high presents of EWC 1701 leads to a higher chromium leaching value

Sulfates are directly related to ceramics and bricks. Italy: in 170904; Spain: both 1701 and 170904

CONCLUSIONS

The analysis of leaching test data on RA shows several criticalities in both analyzed countries, in comparison to the values reported in the Italian M.D. 186/06 and Spanish R.D. 646/2020 and also to the recent Italian EoW regulation

The presence of specific pollutants is strictly related to the heterogeneity incoming waste.

Recycled aggregates risk to be critical due to the presence of some contaminants such as:
- Total chromium
- Copper
- Selenium
- Mercury
- Sulphates (no longer critical in Italy due to the new EoW regulation)
- COD

In any case, however, the number of samples exceeding the limit remains significantly lower for Italy than for Spain related to the respective national Legislation.

Future developments: Evaluate the possibility of applying different leaching tests methods in order to verify the different release of contaminants and pollutants involved, even in situations that represent real uses.

THANK YOU FOR YOUR ATTENTION

This work is developed within the PhD research project “Study of sustainable solutions for the use of recycled materials in the construction sector”, financed by ANCE Brescia (PhD student Andrea Piccinali). The authors wish to thank ANCE Brescia for the support during the research work development and data collection at the CDW treatment plant.
The authors would like to thank AGRECA, Association of Construction and Demolition Waste Management Companies of Andalusia, Ceuta and Melilla (Spain), for its technical collaboration and support during the development of the present study.