Experimental risk assessment of Extensive Green Roofs with fine fraction of mixed recycled aggregates from construction and demolition waste

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University of Córdoba
Spain

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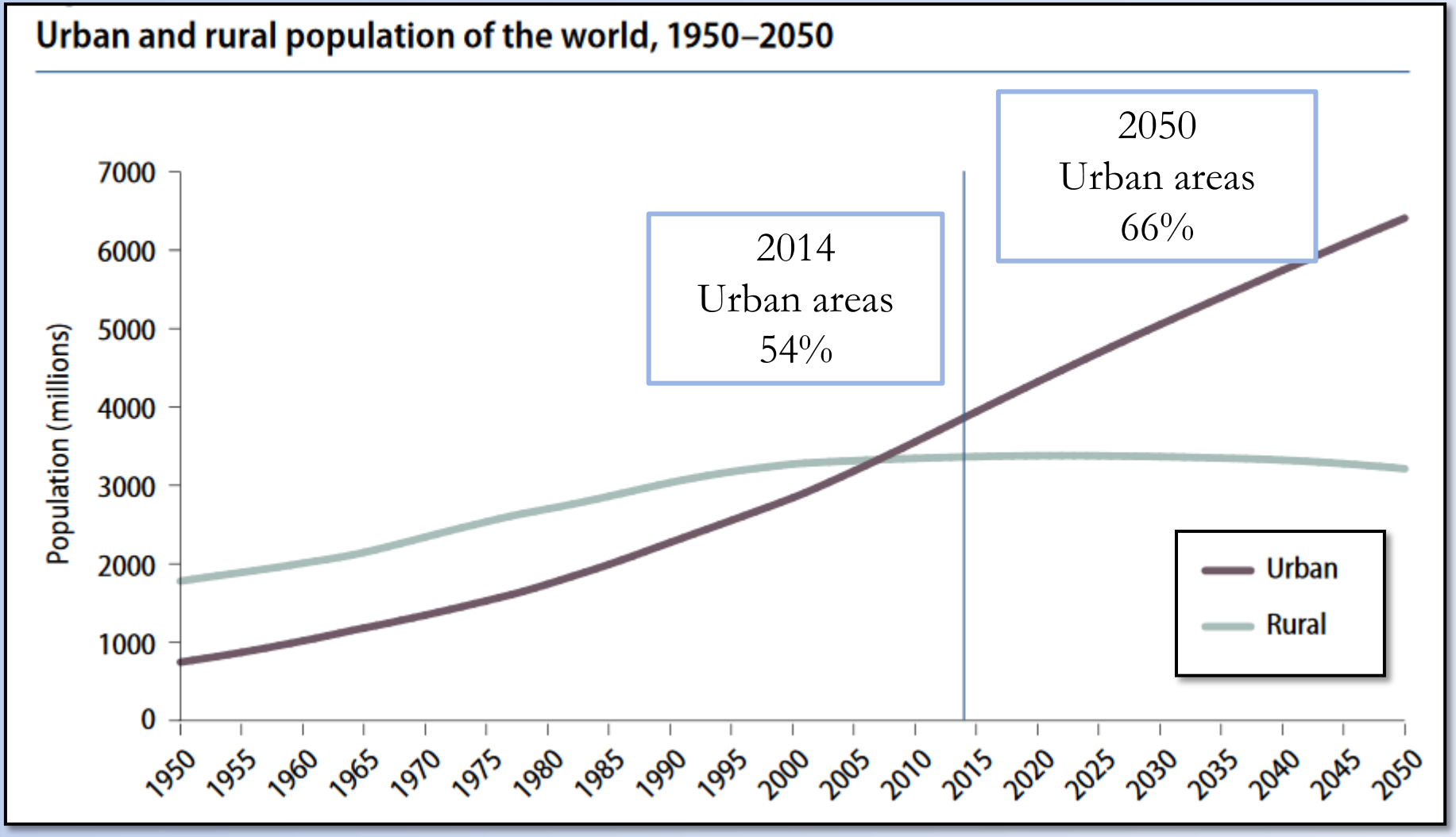

Reference: World Urbanization Prospects: The 2014 Revision. (United Nations, 2014)

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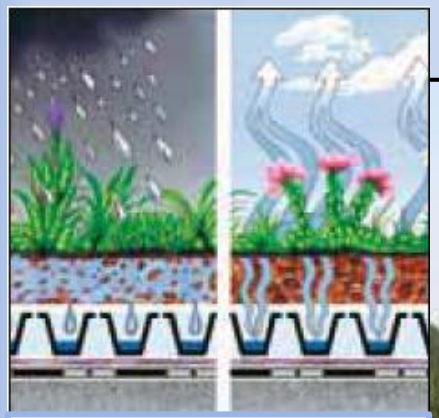
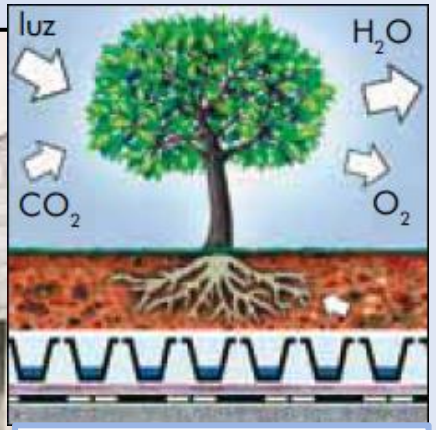


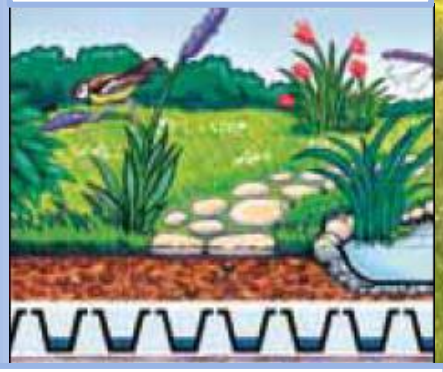
RUNOFF WATER MITIGATION

HEAT ISLAND MITIGATION

THERMAL REGULATION OF BUILDINGS



CARBON STORAGE



WATER AND AIR QUALITY IMPROVEMENT

SOUND PROOFING

Reference: Green Roof Technology

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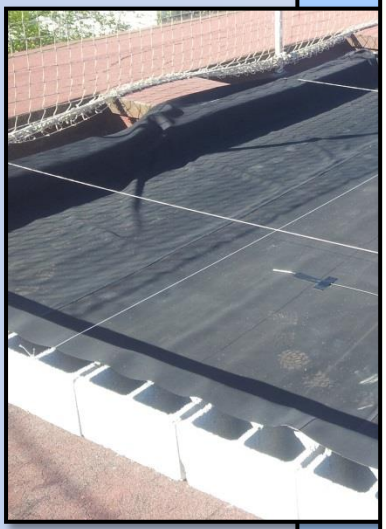

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In Córdoba, heat peaked on 16th June (5 days ago) the highest temperature in Europe in 2017 with 43.8ºC

Extreme heat across Western Europe

Insert city/postcode

Observed maximum temperatures for the Iberian Peninsular on the 16th June 2017. Credit: MeteoGroup.

Extreme heat across Western Europe

17.06.2017 17:23

If you think it's hot in the UK right now, then spare a thought for our neighbours in Iberia. Here, temperatures have been at near record levels for June, with Spain and Portugal experiencing an early summer heatwave.

Although high temperatures are normal in Spain at this time of the year – the average maximum in June for Madrid is 27C for example – the extreme temperatures that have been experienced recently are highly unusual. Madrid reached 40.5C (105F) on the 15th June. Several weather stations broke their monthly records, and the heat peaked on the 16th June, with 43.8C (111F) recorded at Córdoba Airport in south-central Spain. At least 6 provinces were put on a significant amber alert for high temperatures to climb above 40C by the Spanish meteorological agency.

Reference: http://www.weathercast.co.uk/weather-news/

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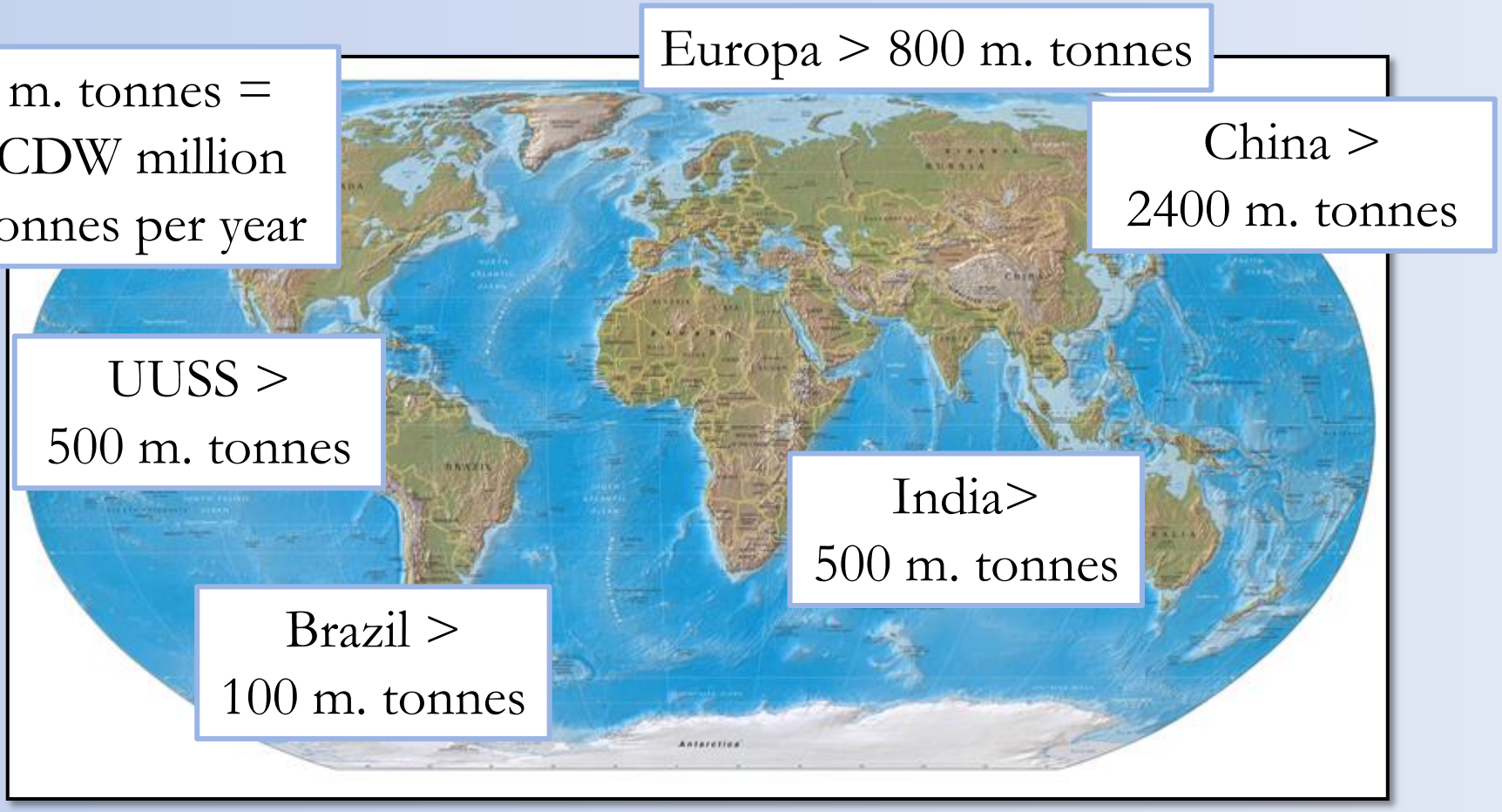

World Construction and Demolition Waste (CDW) Production in tonnes.

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CDW

Recycled aggregates

CDW treatment plant

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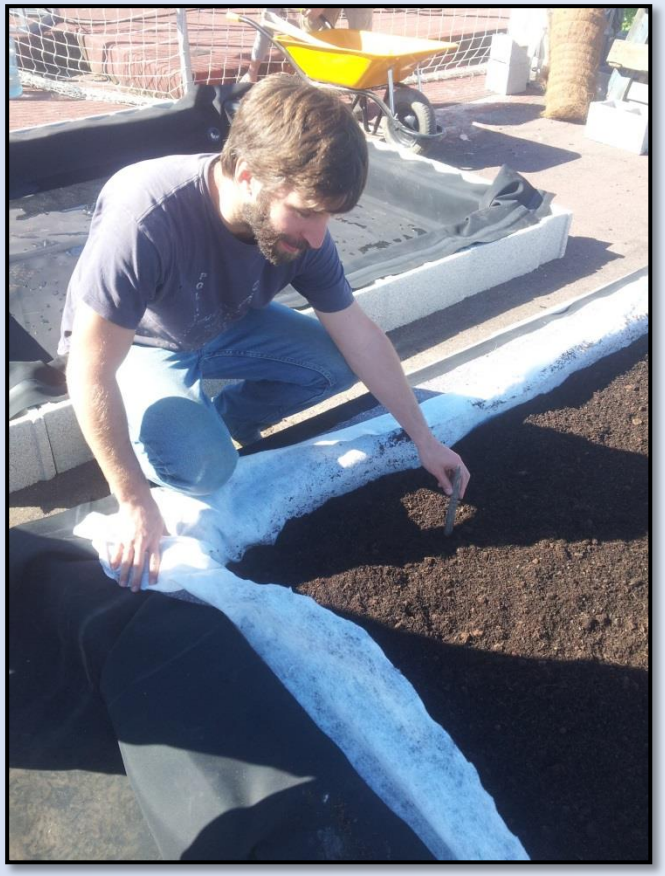
Commercial Vegetable Substrate (CVS)

Fine Mixed Recycled Aggregate (FMRA)



Depth = 10 cms.

Bulk density (g/cm^3)	0.6	1.4
Water absorption (%)	41.3	3.6

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		S100	S50
Fine Mixed Recycled Aggregate (FMRA)			50%
Commercial Vegetable Substrate (CVS)		100%	50%

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THE AIM:

In this **Extensive Green Roof Experiment**, among other issues, we conducted **the experimental risk assessment** of these mixes used as growing medium for vegetation.

For this purpose, we conducted **a long-term "on-site" leaching test** motivated by the Standards requested by the European Committee for Standardization (CEN / TC 292). It proposes an **on-site verification test for long-term prediction** to verify the material´s behaviour, in terms of pollutants emissions, in addition to basic characterization and conformity tests.

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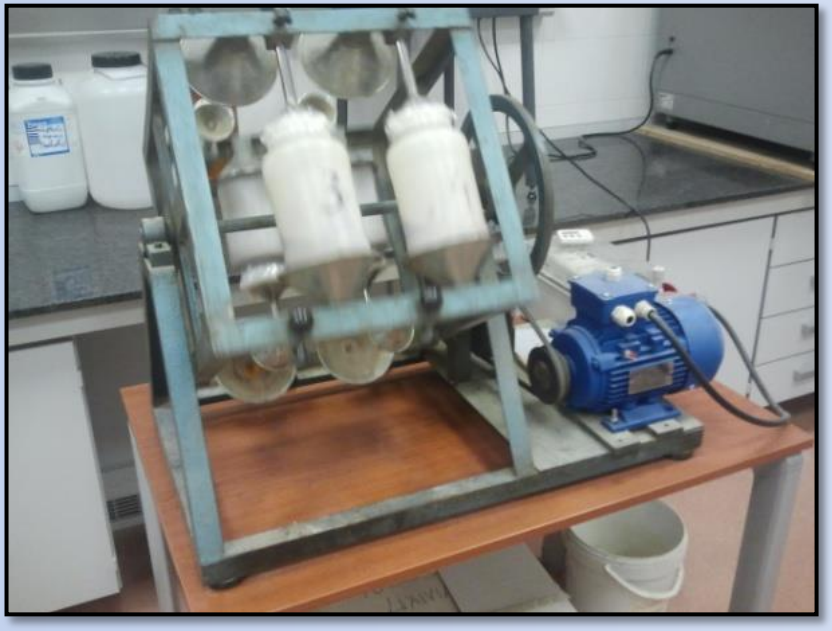
The different leaching test methods used :



Compliance Test (UNE-EN 12457-3:2003)

L/S=2; 10 l/Kg

Column test (NEN 7343:1994)

L/S=0.1; 0.2; 0.5; ,1; 2; 5 l/Kg

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The different leaching test methods used :

" on-site" test carried out in the extensive green roof piece of grounds similar to column test (NEN 7343:1994)

L/S=0.1; 0.2; 0.5; 1; 2; 5 l/Kg

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Compliance test results and the Landfill Directive limits

Element	Landfill Directive Limits L/S = 2 Inert≤ mg/kg	L/S = 2 Non Haz mg/kg	L/S = 2 Haz	L/S = 10 Inert≤ mg/kg	L/S = 10 Non Haz. mg/kg	L/S = 10 Haz	S100 L/S=2 mg/kg	S100 L/S=10 mg/kg	S50 L/S=2 mg/kg	S50 L/S=10 mg/kg
As	≤0.1	0.1-0.4	0.4-6	0.5≤	0.5-2	2-25	0.013	0.067	0.010	0.027
Ba	≤7	7-30	30-100	≤20	20-100	100-300	0.370	0.839	0.136	0.378
Cd	≤0.03	0.03-0.6	0.6-3	≤0.04	0.04-1	1-5	0.000	0.000	0.000	0.001
Cr	≤0.2	0.2-4	4.25	≤0.5	0.5-10	10-70	0.011	0.033	0.070	0.130
Cu	≤0.9	0.9-25	25-50	≤2	2-50	50-100	0.019	0.032	0.013	0.025
Hg	≤0.003	0.003-0.05	0.05-0.5	≤0.01	0.01-0.2	0.2-2	0.000	0.000	0.000	0.001
Mo	≤0.3	0.3-5	5-20	≤0.5	0.5-10	10-30	0.007	0.014	0.115	0.227
Ni	≤0.2	0.2-5	5-20	≤0.4	0.4-10	10-70	0.014	0.012	0.004	0.008
Pb	≤0.2	0.2-5	5-25	≤0.5	0.5-10	10-50	0.000	0.000	0.000	0.000
Sb	≤0.02	0.02-0.2	0.2-2	≤0.06	0.06-0.7	0.7-5	0.002	0.002	0.008	0.036
Se	≤0.06	0.06-0.3	0.3-4	≤0.1	0.1-0.5	0.5-7	0.006	0.006	0.010	0.004
Zn	≤2	2-25	25-90	≤4	4-50	50-200	0.176	0.140	0.012	0.047
Chloride	≤550	550-1·10⁴	(1-1.7)·10⁴	≤800	800-1.5·10⁴	(1.5-2.5)·10⁴	2889	1617	440	500
Fluoride	≤4	4-60	60-200	≤10	10-150	150-500	<1	<5	<1	<5
Sulphate	≤560	560-1·10⁴	(1-2.5)·10⁴	≤1·10³	1·10³-2·10⁴	2·10⁴-5·10⁴	6366	9380	4110	12570

Non Haz= Non Hazardous; Haz=Hazardous

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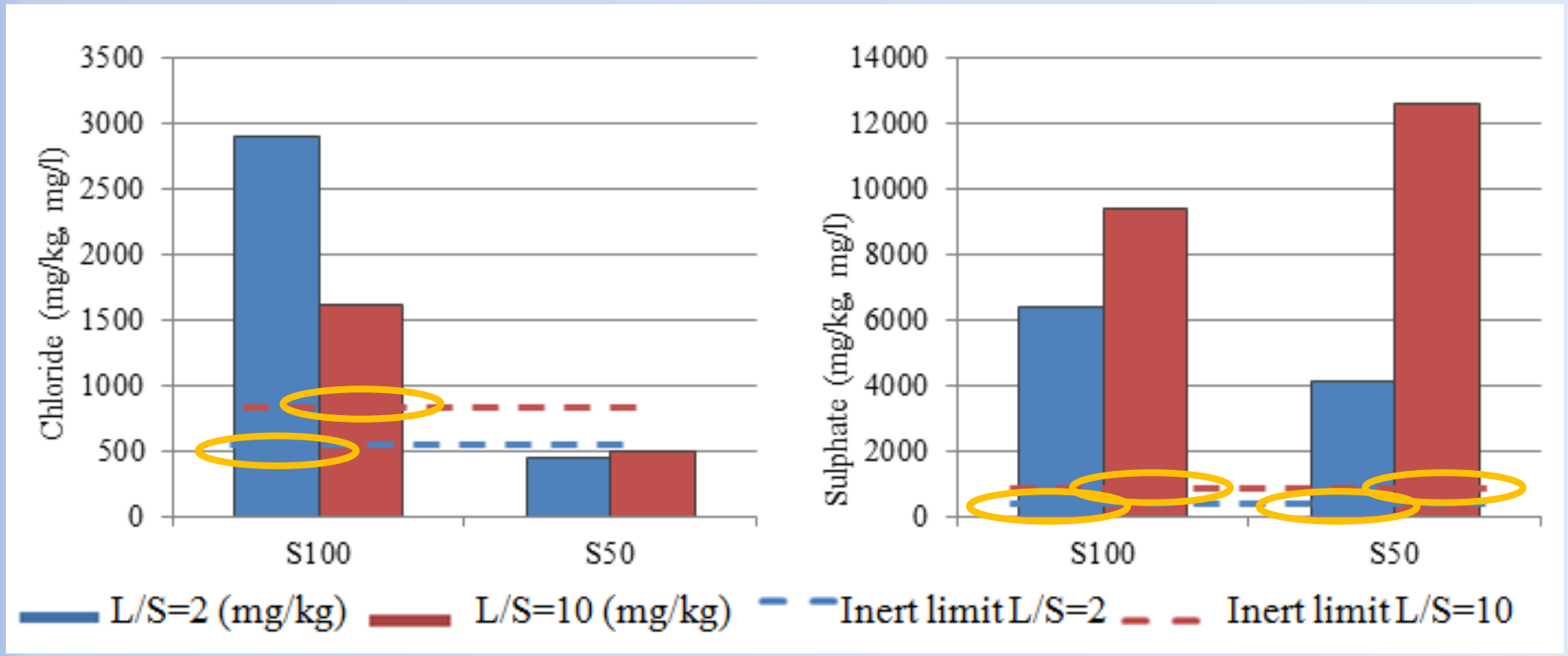
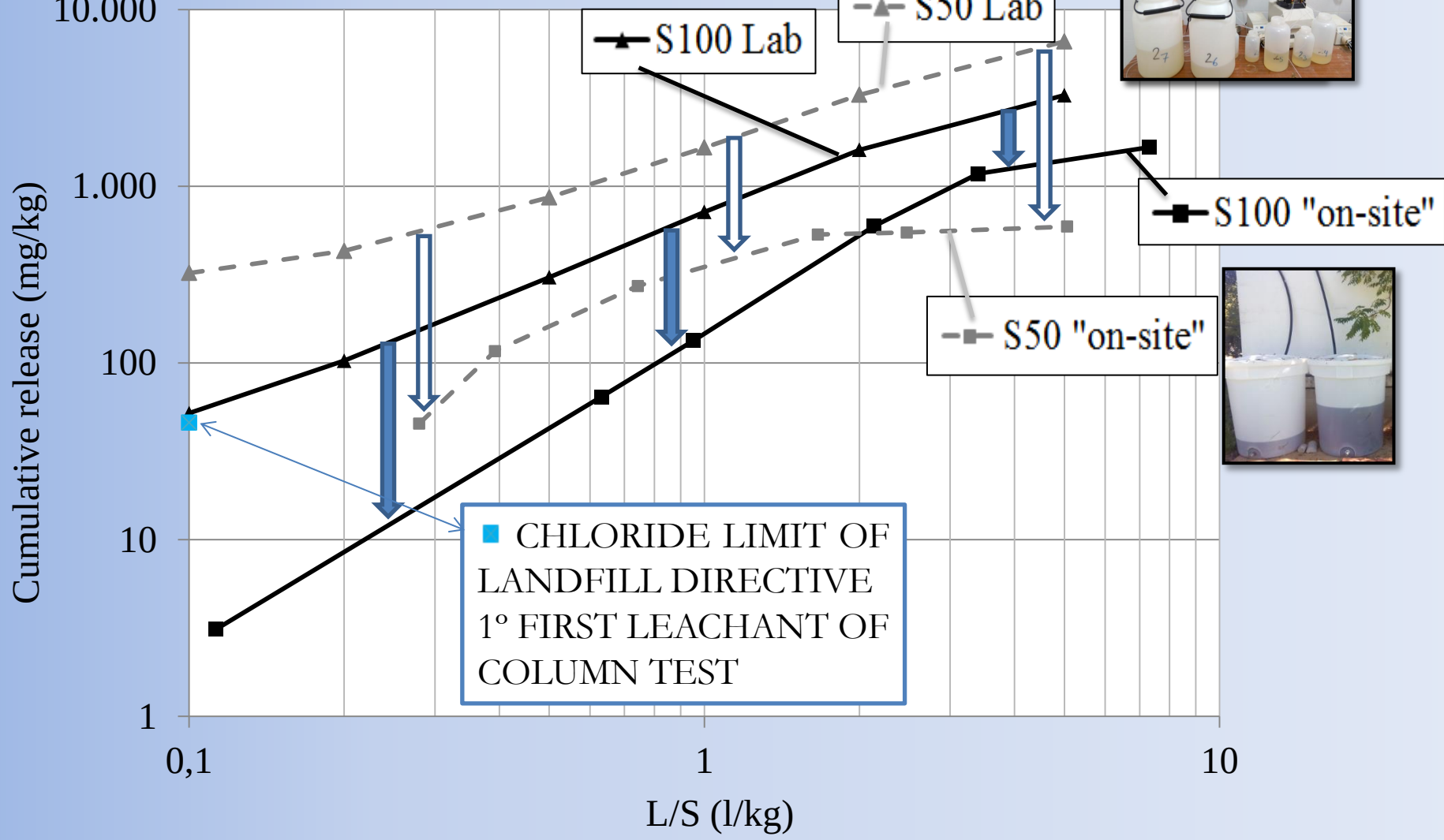
Compliance test results and the Landfill Directive limits

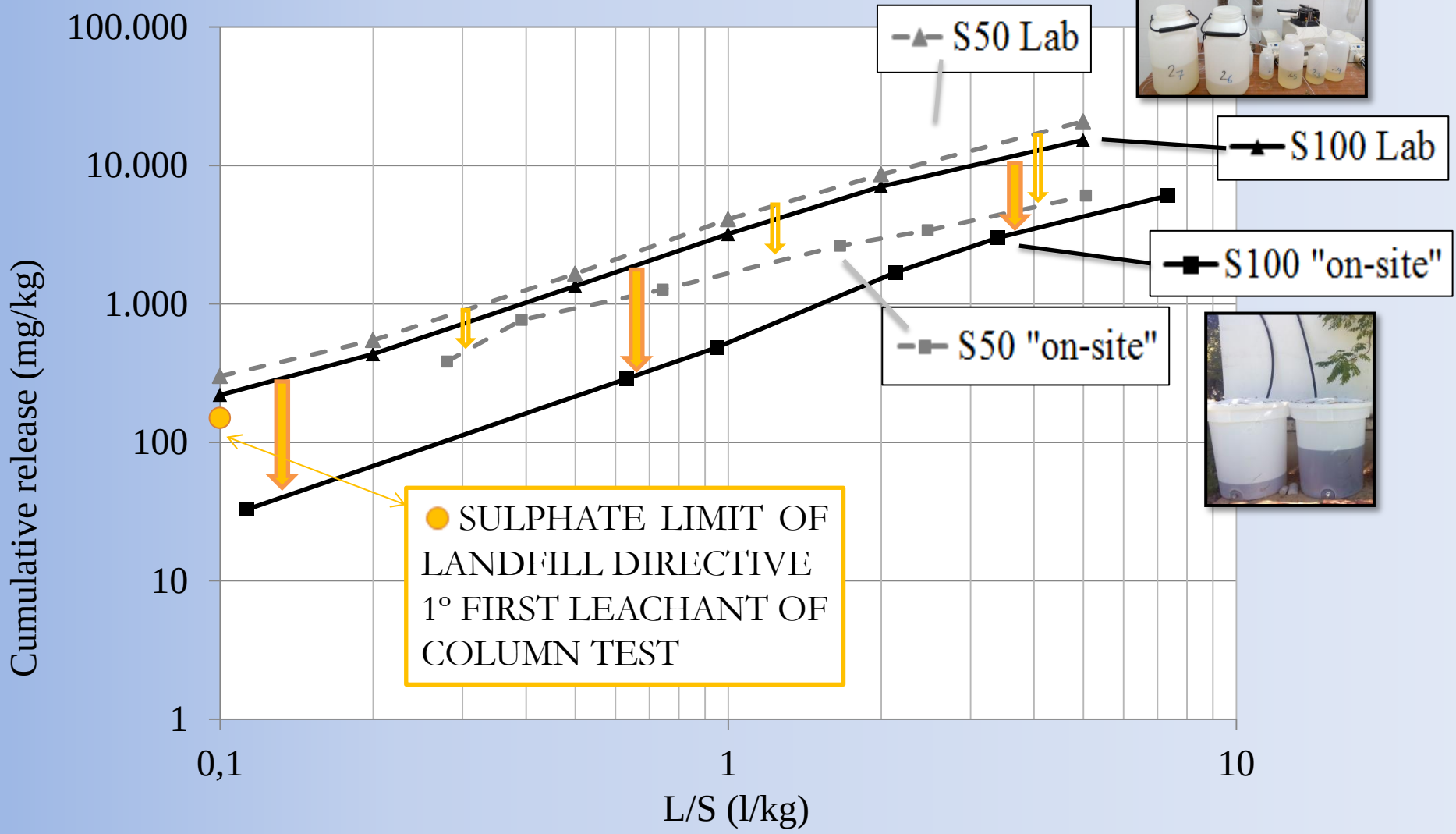


Comparison Lab to on-site CHLORIDE



Comparison Lab to on-site

SULPHATE



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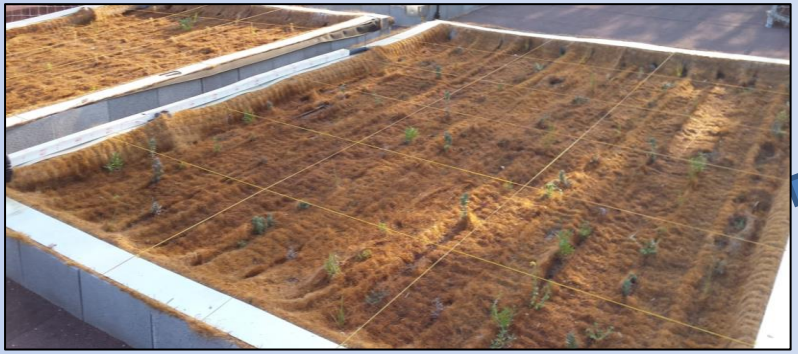

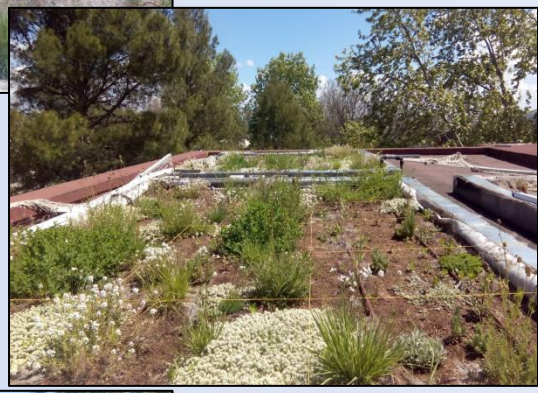

- The 12 Mediterranean plants selected did not show any significant difference in terms of survival and cover surface respect to the mix used as growing medium for vegetation.

Conclusion:

The experimental risk assessment of extensive Green Roofs with fine fraction of MRA from CDW, here presented indicates:

→ Real application of FMRA with CVS as substrates in extensive green roofs, release less amount of sulphate and chloride anions in comparison to laboratory. It implies that the effect of laboratory conditions can overestimate the potential pollutant of these materials.

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Thank you for your attention

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Acknowledgements

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