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INERTWASTE

**Transforming inert waste into technosoils
for the restoration of mining areas.
Restoration of the mine of Eugi (northern
Spain).**

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CONTEXT

- MAGNA is a mining company, leader in the production of magnesium oxide based solutions.
- Located in Navarra (northern Spain), it operates in 45 countries.
- MAGNA has the commitment to restore its mine of Eugi (Navarra).



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KEY ISSUES OF THIS PRACTICE

- **WASTE ACCUMULATION:**
 - Lack of space to store inert waste derived from MAGNA's manufacturing process.
 - $> 21.707 \text{ m}^3$ sludges/year.
- **SCARCITY OF SOIL FOR RESTORATION:**
 - High demand of topsoil: $> 10.000 \text{ m}^3$ /season.
 - Lack of extraction sites.
 - High transport costs: 40 km per truck journey.
 - Poor soil quality: cold, from deep



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SOLUTION FOR THE KEY ISSUES

- Using the inert waste generated by the factory to create technosoils for the restoration of the mine.
- *“Technosoil”: engineered soil created for land improvement, made using a mix of organic and inorganic materials.*
- A pilot project was conducted in 2019-2024.



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PILOT PROJECT

- Total cost: 667.753€
- Public funding: 12%



Regional



National

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PILOT PROJECT: DESIGN OF THE TECHNOSOIL MIXTURE

- 5 technosoil mixtures were prepared + control soil.
- Mixtures were designed to achieve a loam soil texture.
- All the inert waste used came from MAGNA.
- Organic matter was introduced for soil fertility enhancement.

		Technosoi I 1	Technosoi I 2	Technosoi I 3	Technosoi I 4	Technosoi I 5	Control soil	
MAGNA materials (all inert, without contaminants nor heavy metals)	% in the mix						Natural soil of the mine	
	Inorganic waste (INERT)	Sand 1-4 mm	20	20	30	20		20
		Sand 4-12 mm	20	20	0	20		20
		Sulfamag	0	0	15	0		0
		Sludge	30	35	30	35		30
Flotation tailings		15	15	15	15	15		
Organic waste	Peat	0	0	0	5	0		
	Compost	15	10	10	5	10		
	Manure	0	0	0	0	5		
	Struvite	0.1	0.1	0.1	0.1	0.1		
Nearby organic matter input								
Phosphorus supply								

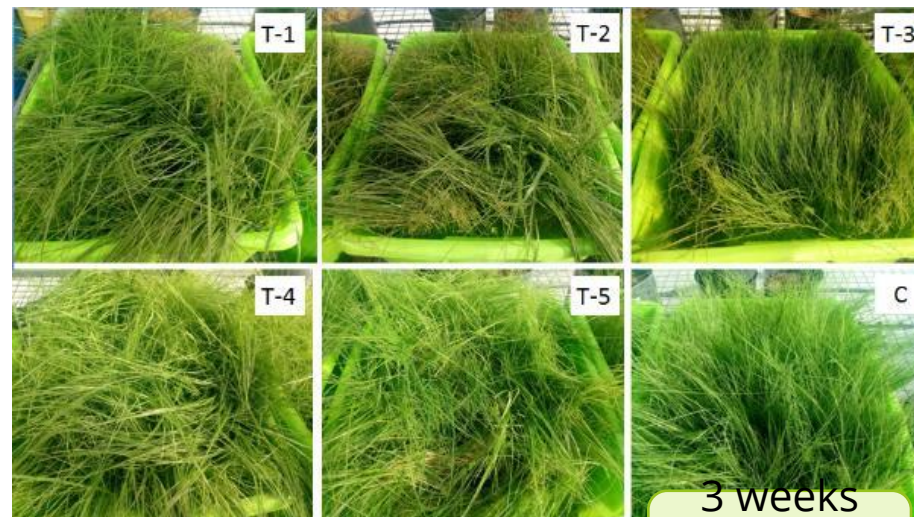
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PILOT PROJECT: GREENHOUSE AND LABORATORY TRIALS

- Soil samples taken every 15 days during one year.
- Technosoils #1 and #5 were selected as best options due to high nutrient availability, rapid surface coverage, good height growth, and correct pH/conductivity.



Time of sowing



3 weeks after sowing

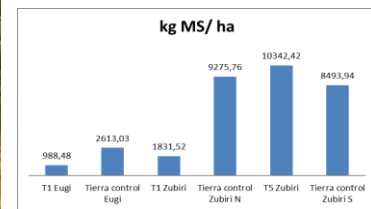
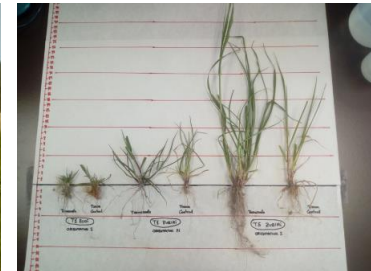
Technos oil	Sand	Clay	Silt	Texture	Ph	CE	O.M. %
1	31	9.6	59.4	silty-loam	8.24	446	1.2
2	36.9	17.8	45.3	loam	8.66	171.7	1.05
3	61	25.4	13.6	silty-clay-loam	9.4	2490	0.9
4	30	12.6	57.4	silty-loam	9.11	566.5	1.01
5	38.6	4.8	56.6	silty-loam	8.44	233.9	2.01
Control soil	82	2.4	15.6	sandy	7.31	158.5	3.07

Example of results

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PILOT PROJECT: FIELD TEST

- Field tests were carried out with technosoils #1 and #5.
- The mixture was prepared on a larger scale and spread in various locations.
- Under outdoor conditions, technosoil #5 showed the highest cover and herbaceous growth, due to the manure content. Similar properties or



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PILOT PROJECT: OTHER TECHNOSOIL APPLICATIONS

- Additional tests were carried out to evaluate the potential of technosoils for recreating natural grassland.
- Technosoils achieved good vegetation cover and similar species diversity compared to other soils.



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CONCLUSIONS AND NEXT STEPS

- Technosoils help to convert waste into a resource, and have shown to be viable for landscape restoration.
- Technosoils created from MAGNA's inert waste address the issues of storage limitations and the scarcity of soil in the market.
- MAGNA plans to scale-up the use of technosoils in the restoration of entire slopes.
- The Government of Navarra will use this practice to improve the ERDF within the INERTWASTE project.



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MAIN CHALLENGES

- **Scalability:** scaling up the production of technosoils to integrate large-scale projects in the production system of MAGNA.
- **Cost and logistics:** producing, transporting, applying technosoils at large scales may require significant investments in infrastructure and equipment.
- **Designing appropriate mixtures:** creating technosoils with the necessary physical, chemical, and biological properties for vegetation growth requires a deep



Thank you
¡Gracias!
Eskerrik asko!

www.interregeurope.eu/INERTWASTE