SUMAD
Sustainable Use of Mining Waste Dumps

GIG Research Institute

DUMP REMEDIATION AND POSSIBILITIES FOR GRASS CULTIVATION

HR EXCELLENCE IN RESEARCH

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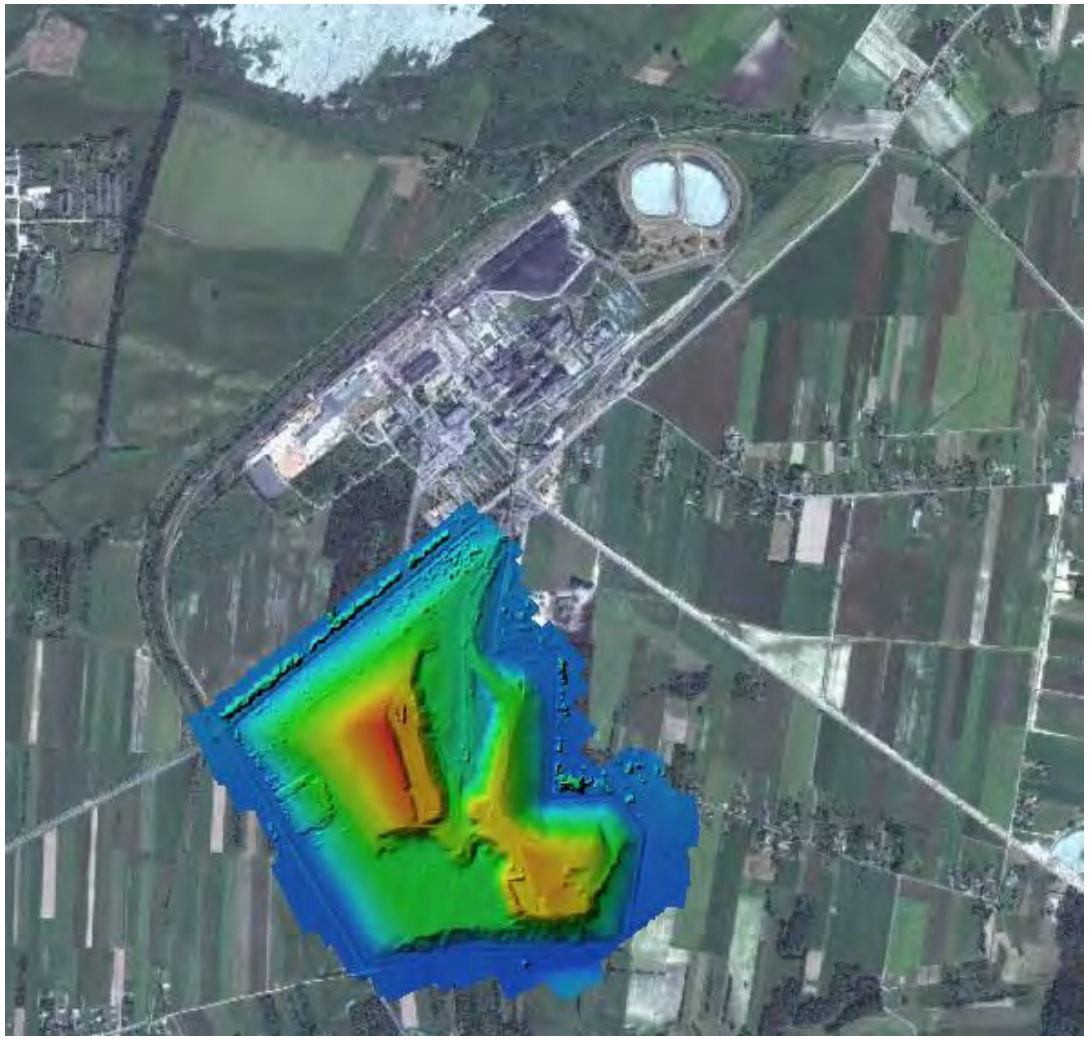
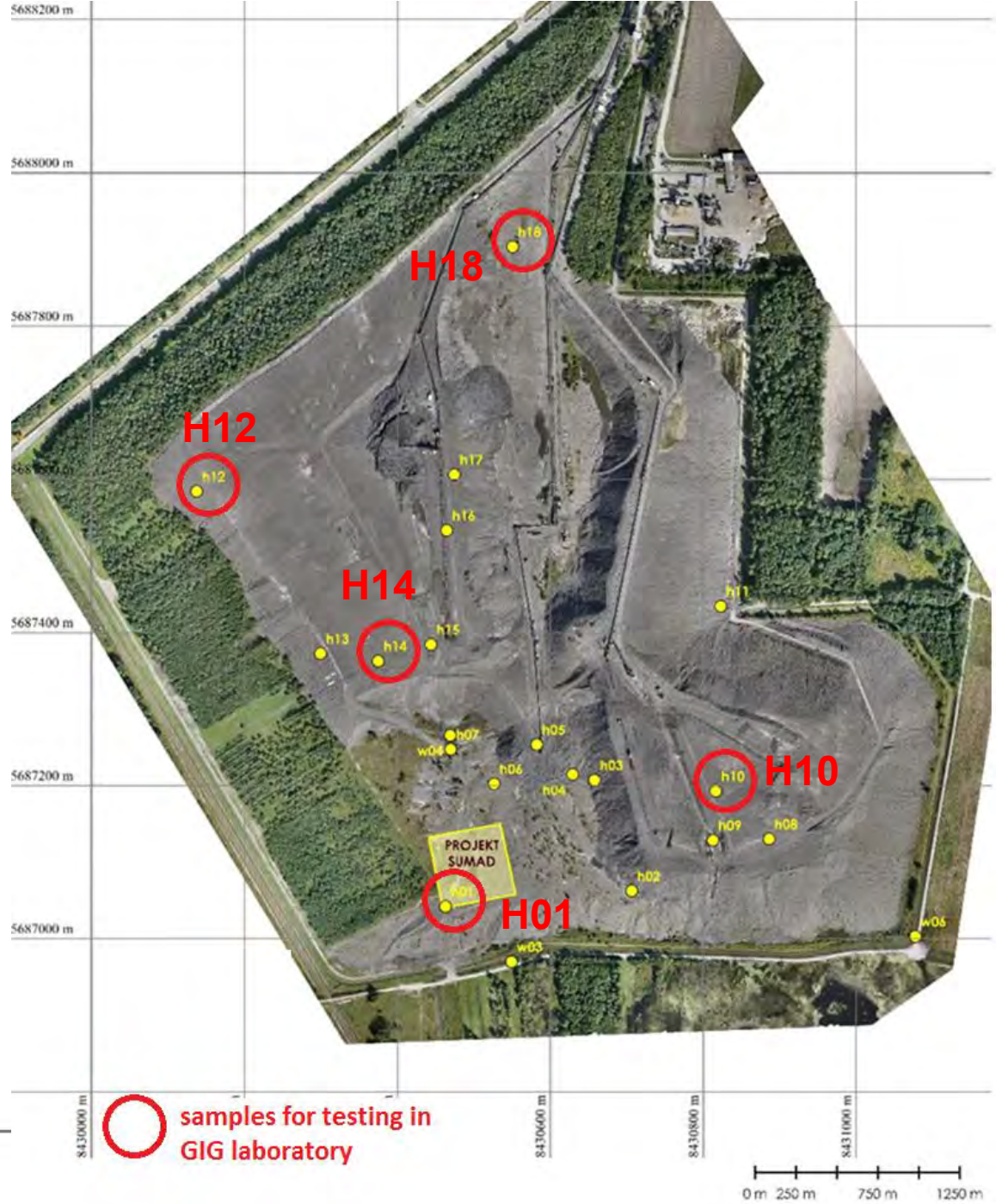
Wrocław, 6th October 2022

MINE-WASTE DUMP AREA OF THE MINE LW BOGDANKA



SAMPLING


5688200 m
5688000 m
5687800 m
5687400 m
5687200 m
5687000 m
H18
H12
H14
H10
H01
h18
h12
h17
h16
h11
h13
h14
h15
h07
h05
w04
h06
h03
h04
h10
h09
h08
PROJEKT
SUMAD
h01
h02
w03
w05
samples for testing in
GIG laboratory
8430000 m
8430400 m
8430800 m
8431000 m
0 m 250 m 750 m 1250 m

ANALYSIS

The following tests were carried out:

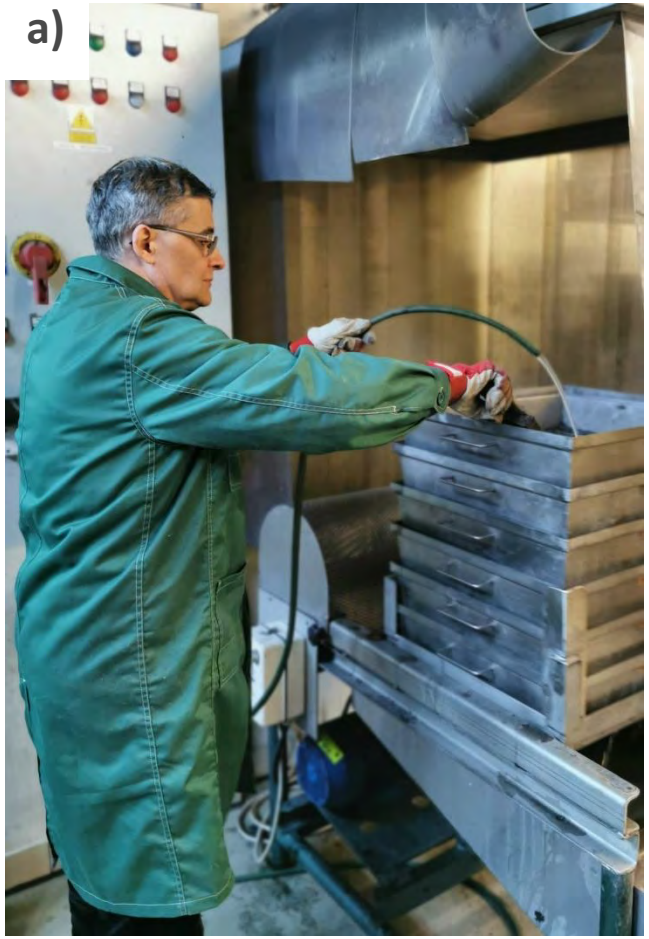
- **grain analysis**
- **chemical composition of water extract**
- **mineral composition**
- **SEM EDS analysis**
- **phytotoxicity tests**

Figure. Waste samples from dump LW Bogdanka - sample dried and averaged for testing

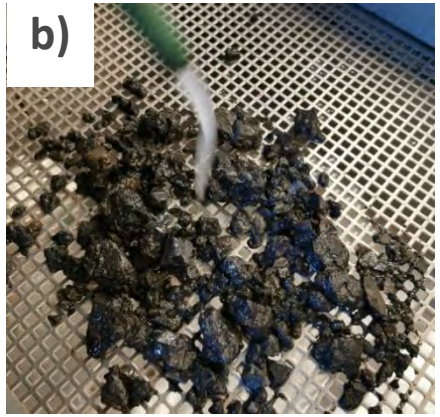
GRAIN ANALYSIS

Wet sieving method

a)



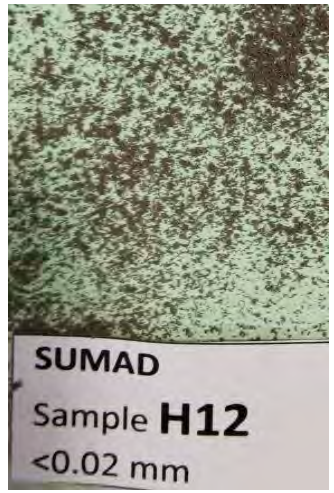
b)

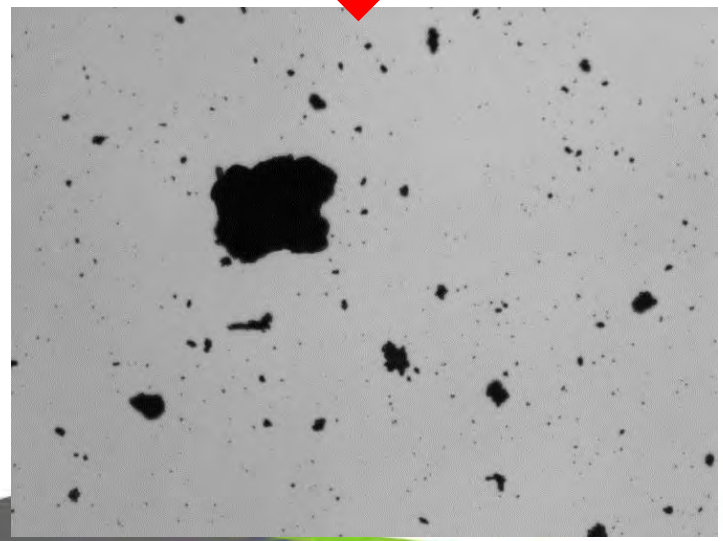


c)

Wet sieve analysis a, b) in the range above 0.2 mm with the use of a large laboratory shaker with reciprocating motion and test sieves with a side of 45 cm, c) in the range less than 0.2 mm using a laboratory vibrating shaker by FRITSCH and test sieves with a diameter of 200 mm

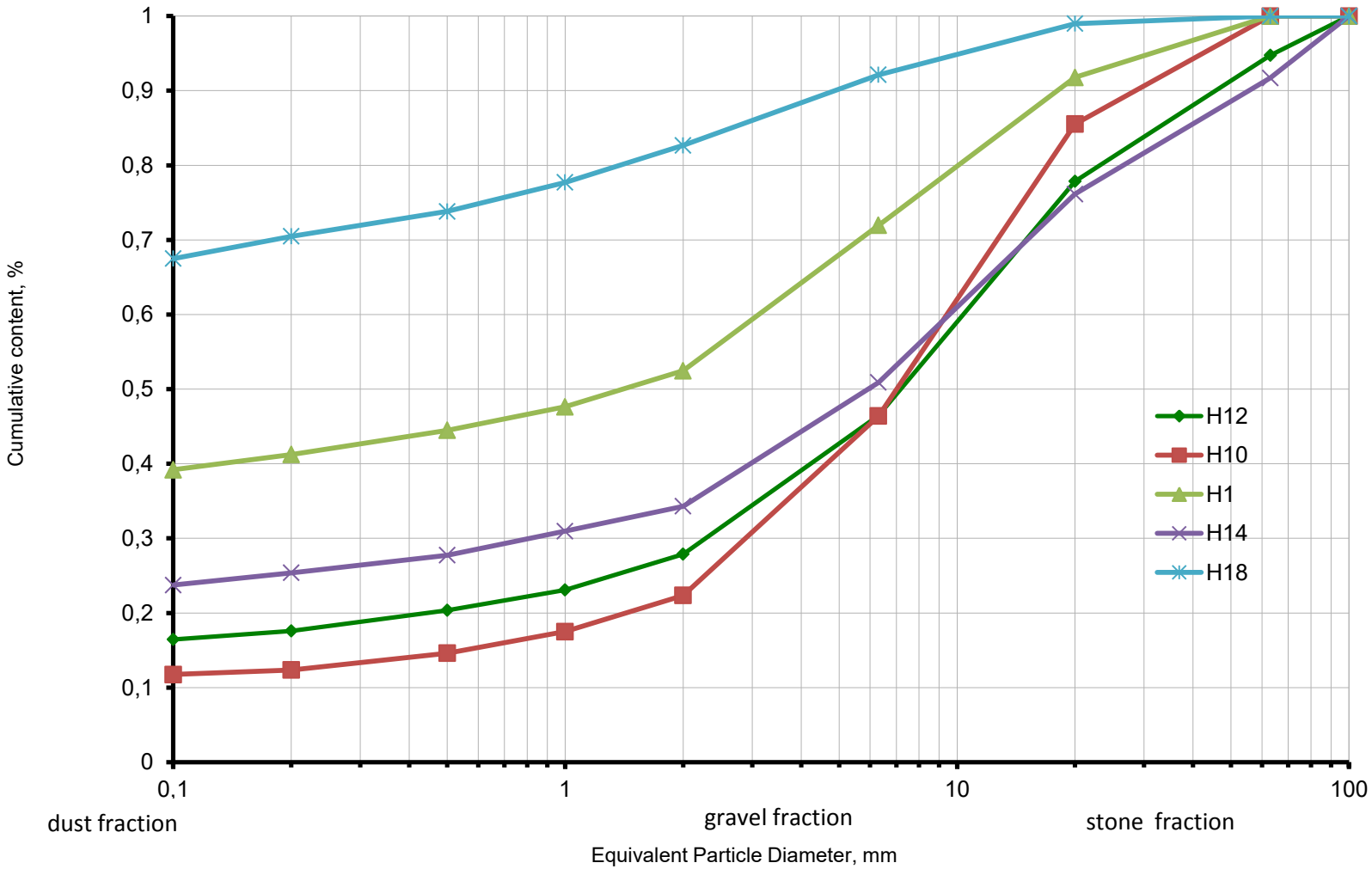
Optical method





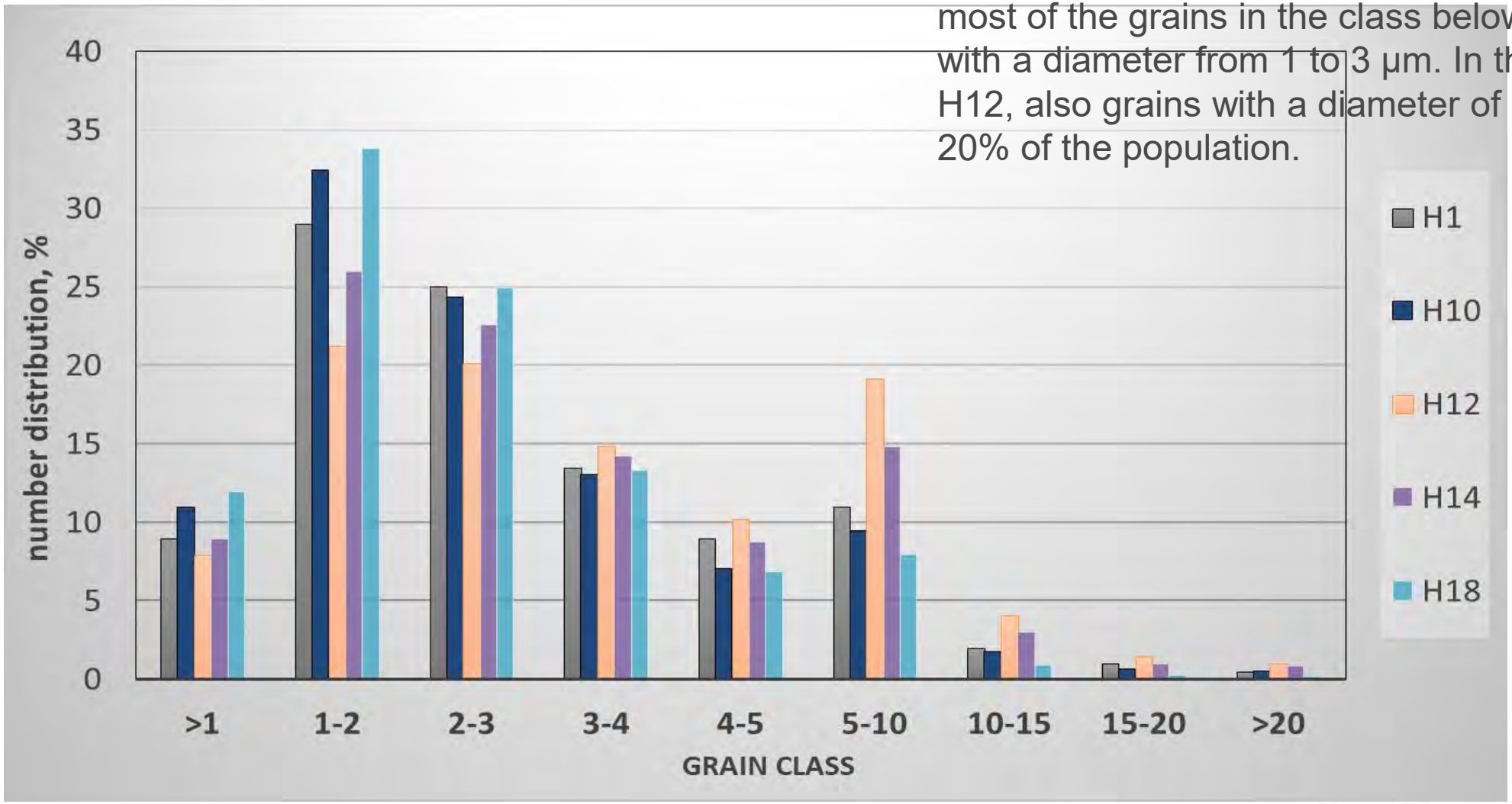
to determine the particle size distribution in a class below 20 µm - Optical analysis using G3S-ID analayzer

GRAIN ANALYSIS



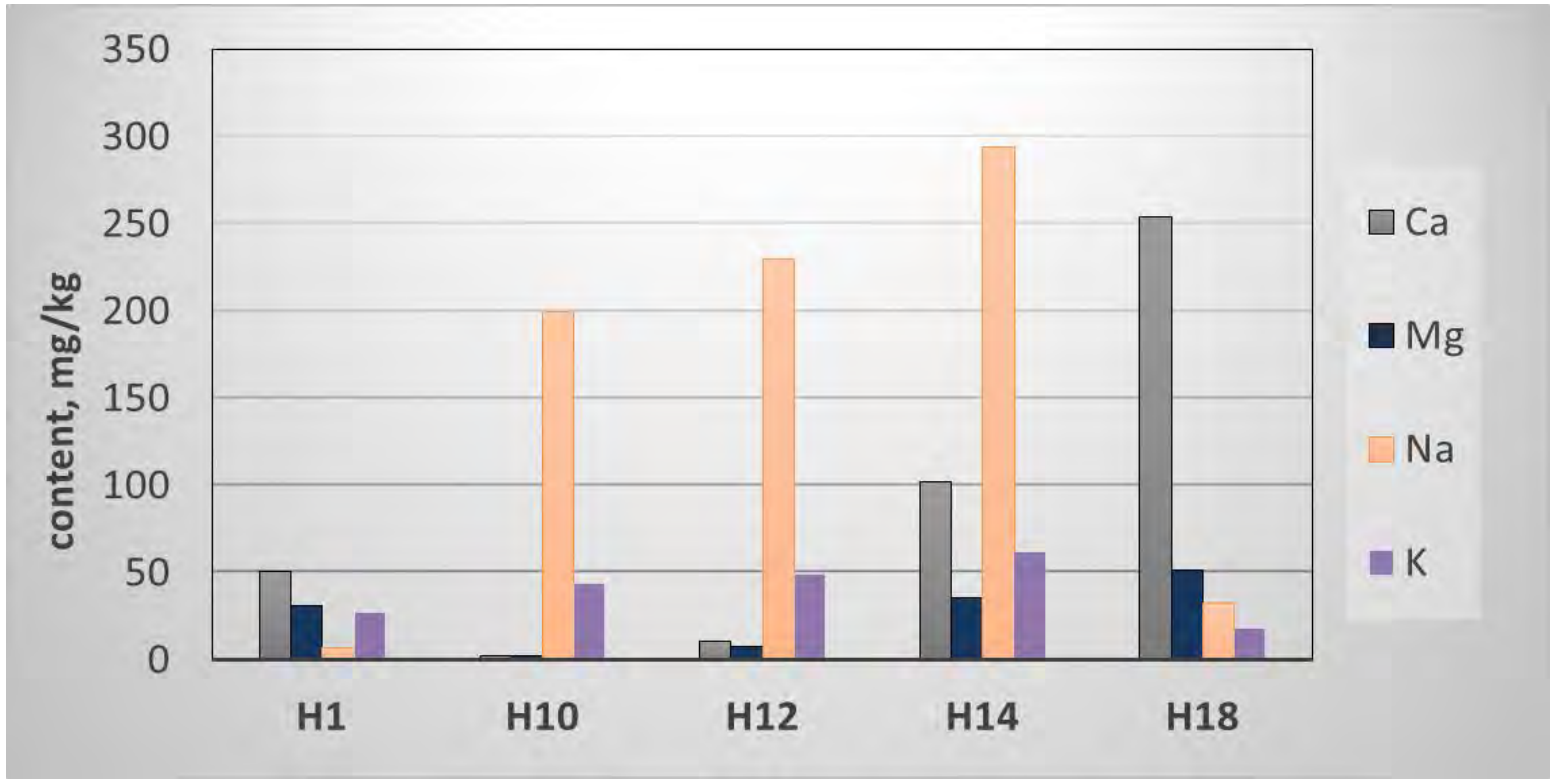
- *the finest material were samples H18 and H1*
- *the highest content was dust fractions*

GRAIN ANALYSIS OF FINE DUST FRACTION AND CLAY FRACTION (CLASS <20µm)



most of the grains in the class below 20 µm are grains with a diameter from 1 to 3 µm. In the case of sample H12, also grains with a diameter of 5-10 µm represent 20% of the population.

CHEMICAL COMPOSITION OF WATER EXTRACT

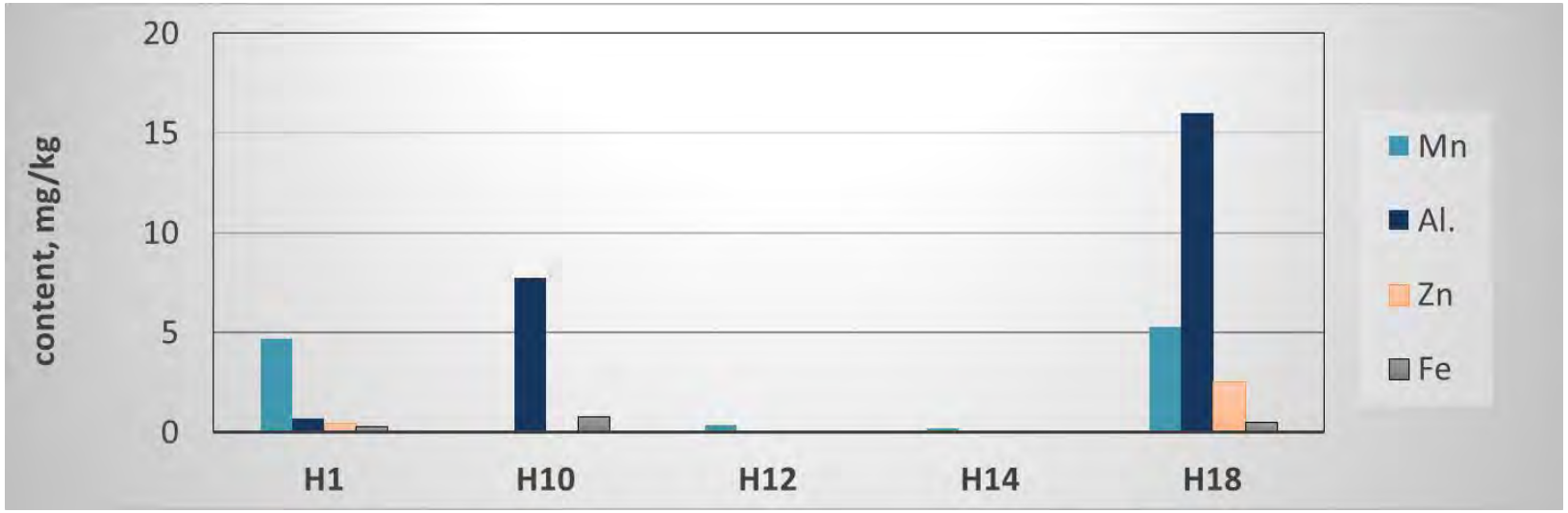


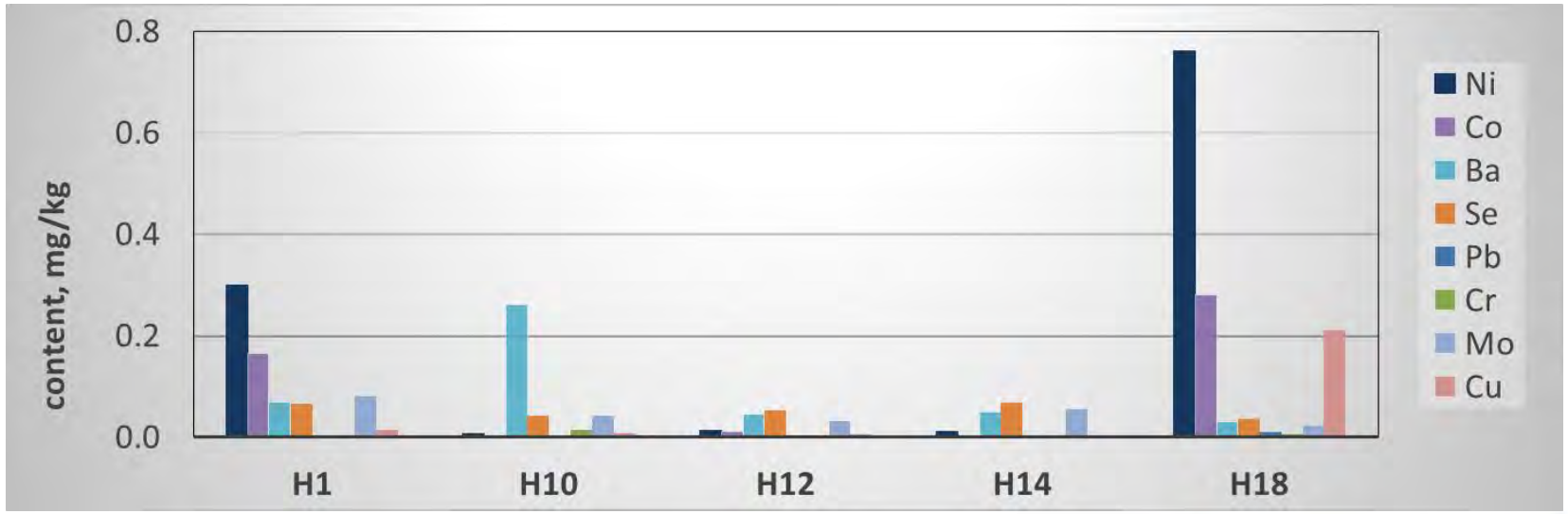
In the water extract obtained from samples H10, H12 and H14, the sodium content was 200 mg/kg, 230 mg/kg and 300 mg/kg dry mass, respectively.

In the water extract obtained from samples H18 and H14, the calcium content amounted to 250 mg/kg and 100 mg/kg dry mass, respectively.

The potassium content in the obtained water extracts ranged from 18 mg/kg (sample H18) to 62 mg/kg (sample H14) .

CHEMICAL COMPOSITION OF WATER EXTRACT

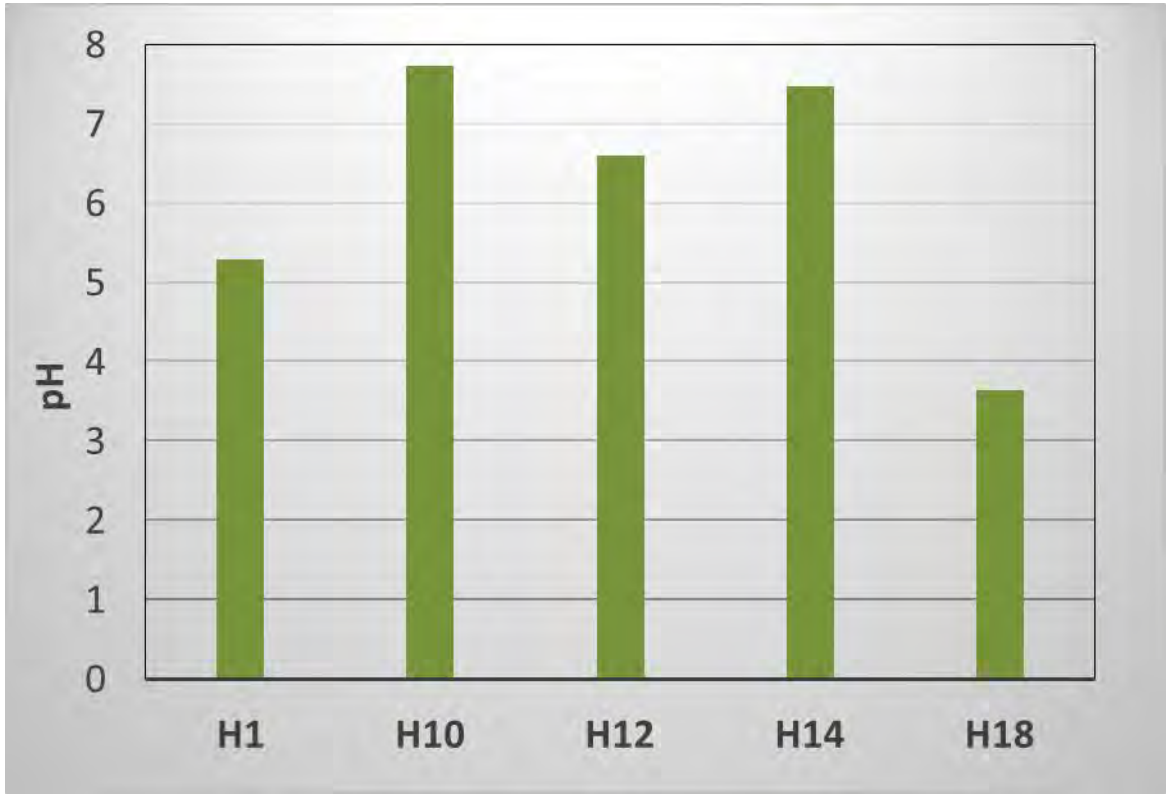


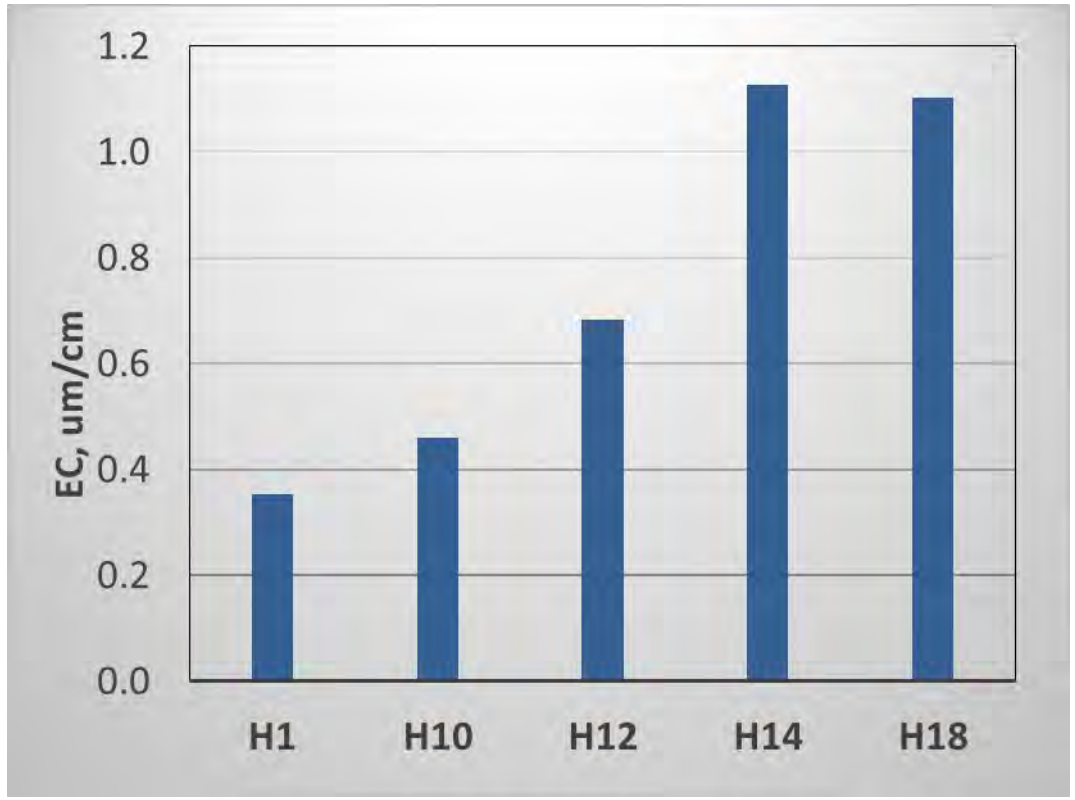


Moreover, in the water extract obtained from the H1 samples, Mn was determined in the amount of about 5 ppm as well as Ni and Co at the level of 0.2 ppm.

In the water extract obtained from the H10 samples, **Al** was determined in the amount of about 8 ppm and **Ba** at the level of 0.2 ppm.

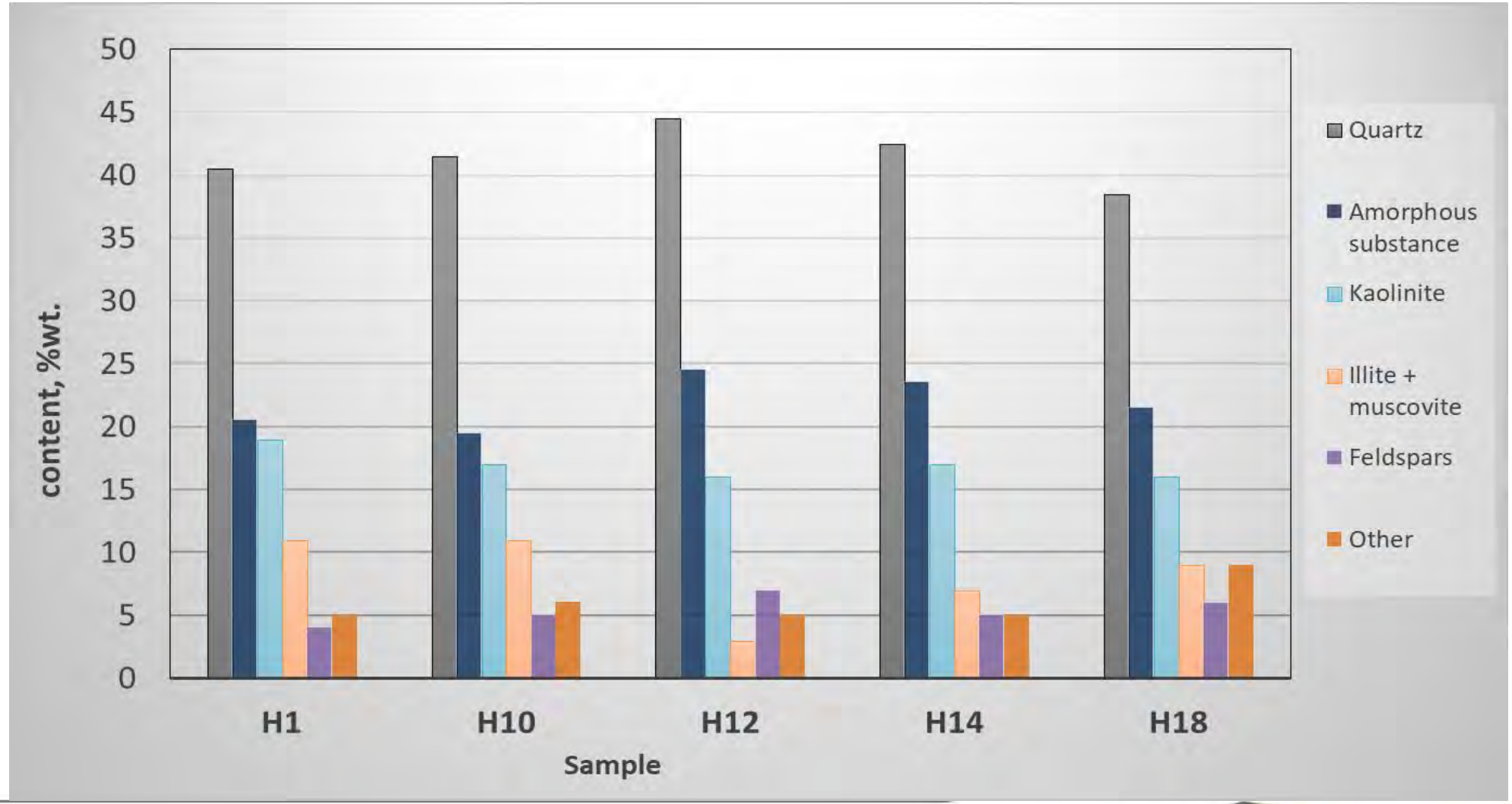
CHEMICAL COMPOSITION OF WATER EXTRACT





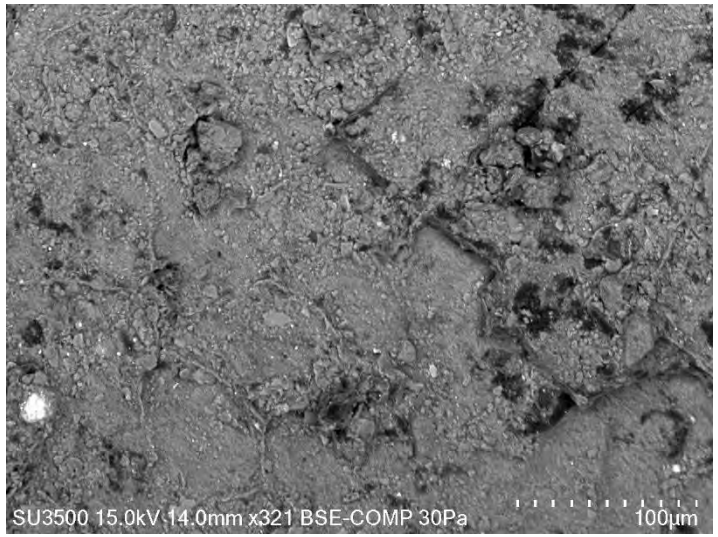
The water extract obtained from the H18 sample was characterized by the highest metal content. This extract was also the lowest pH value - below 4.

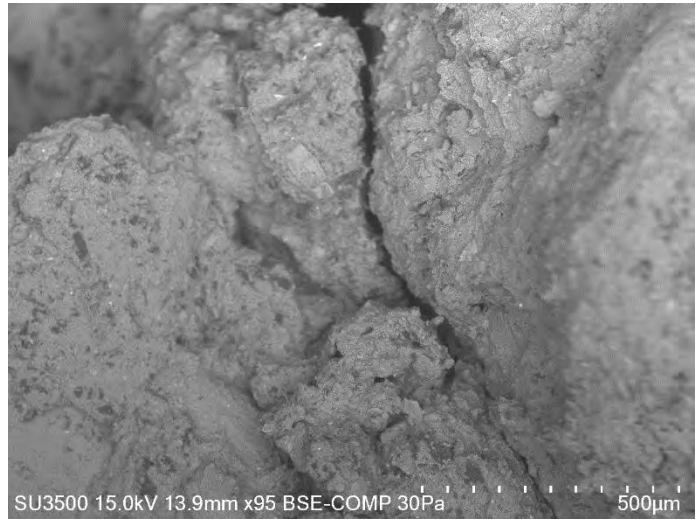
MINERAL COMPOSITION

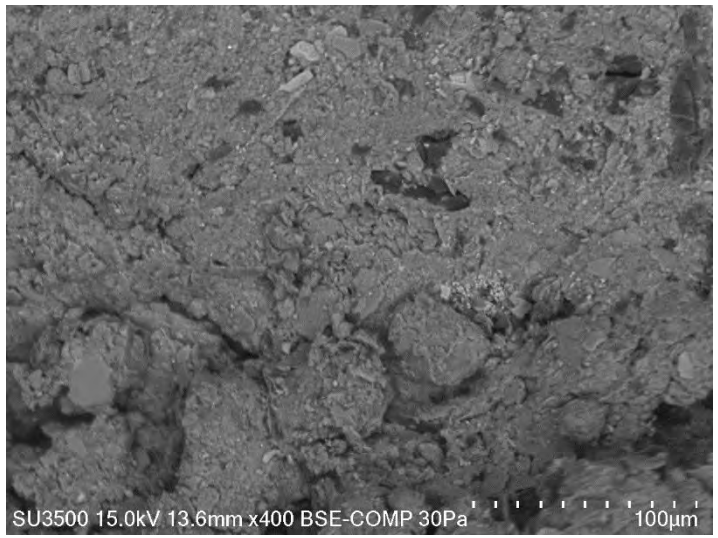


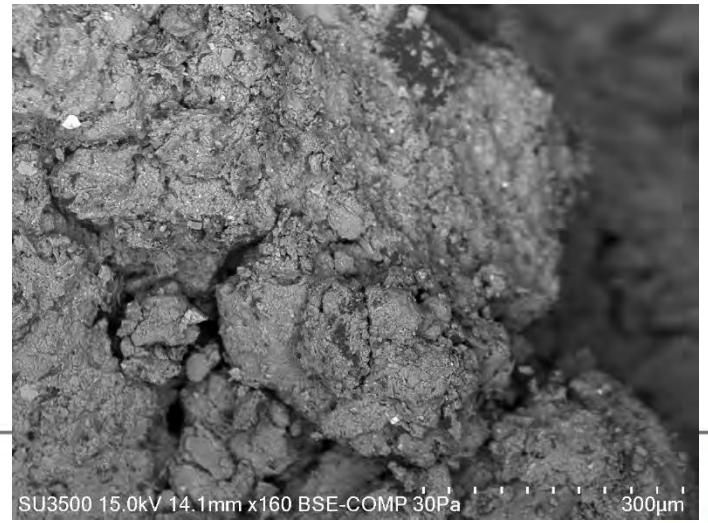
SEM/EDS ANALYSIS

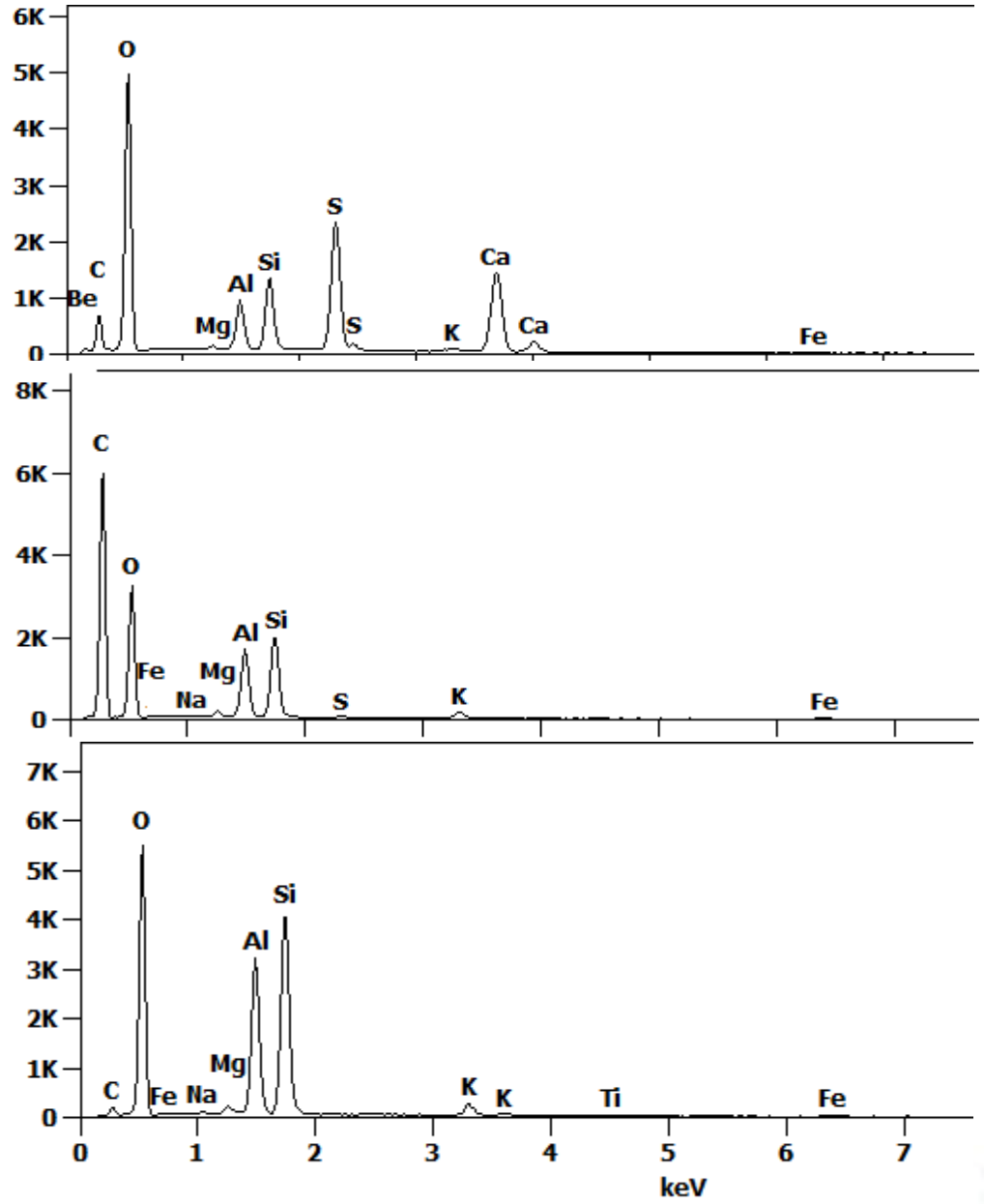
The SEM-EDS analysis confirmed that the selected mine-waste is aluminosilicates with admixtures of magnesium, sodium, iron, calcium, potassium, sulfur and titanium



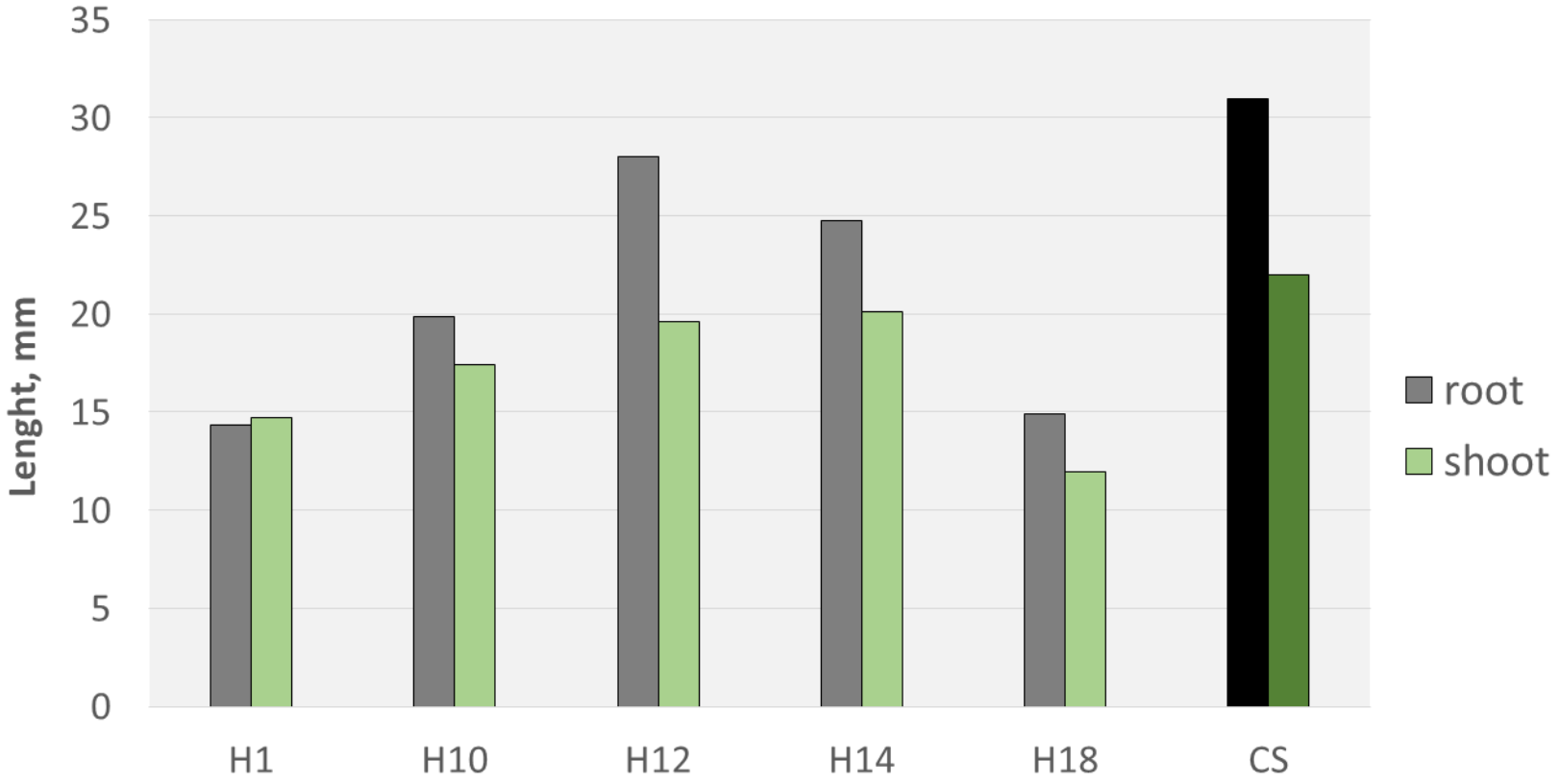


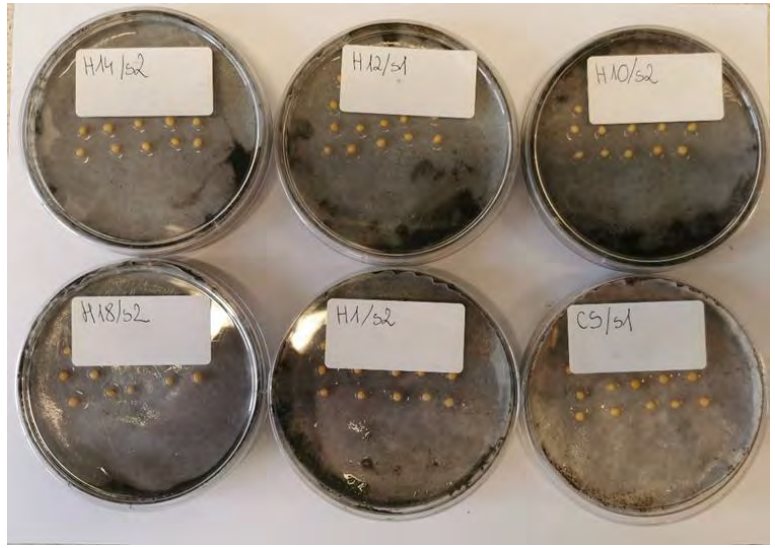






PHYTOTOXICITY TESTS

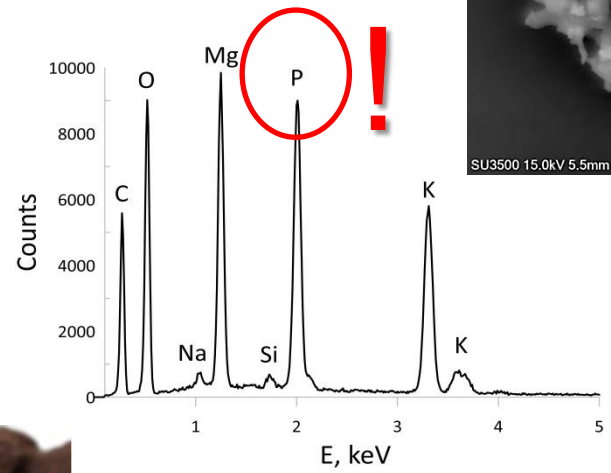


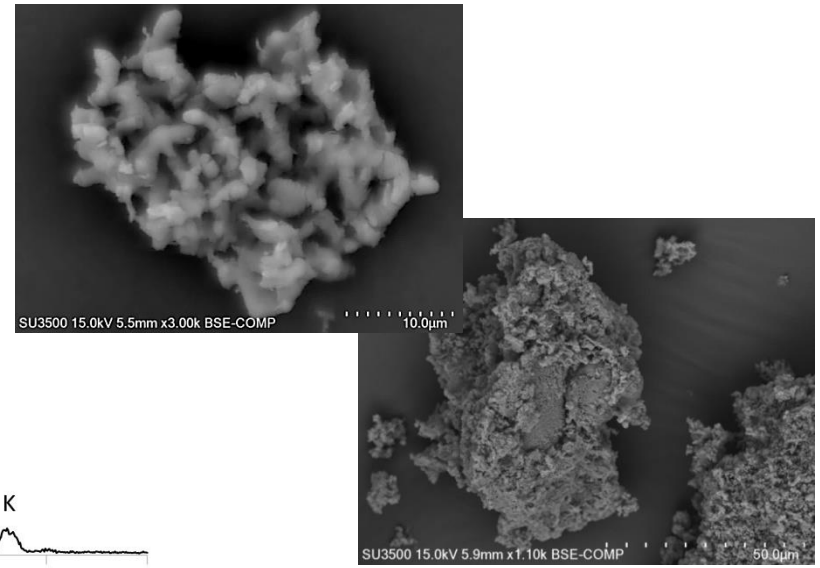


EXPERIMENTAL FERTILIZER ADDITION

- **ash from poultry manure incineration**

[Cempa et al. 2022, DEASPHOR]



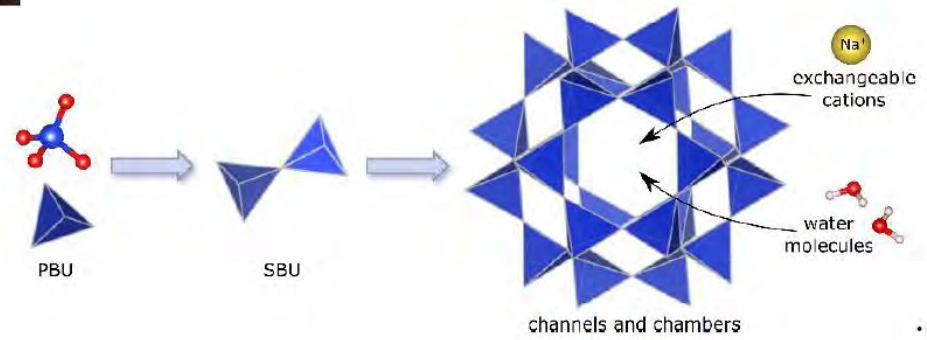


- **spent coffee ground**

[Ciesielczuk et al. 2017, Lee 2021]

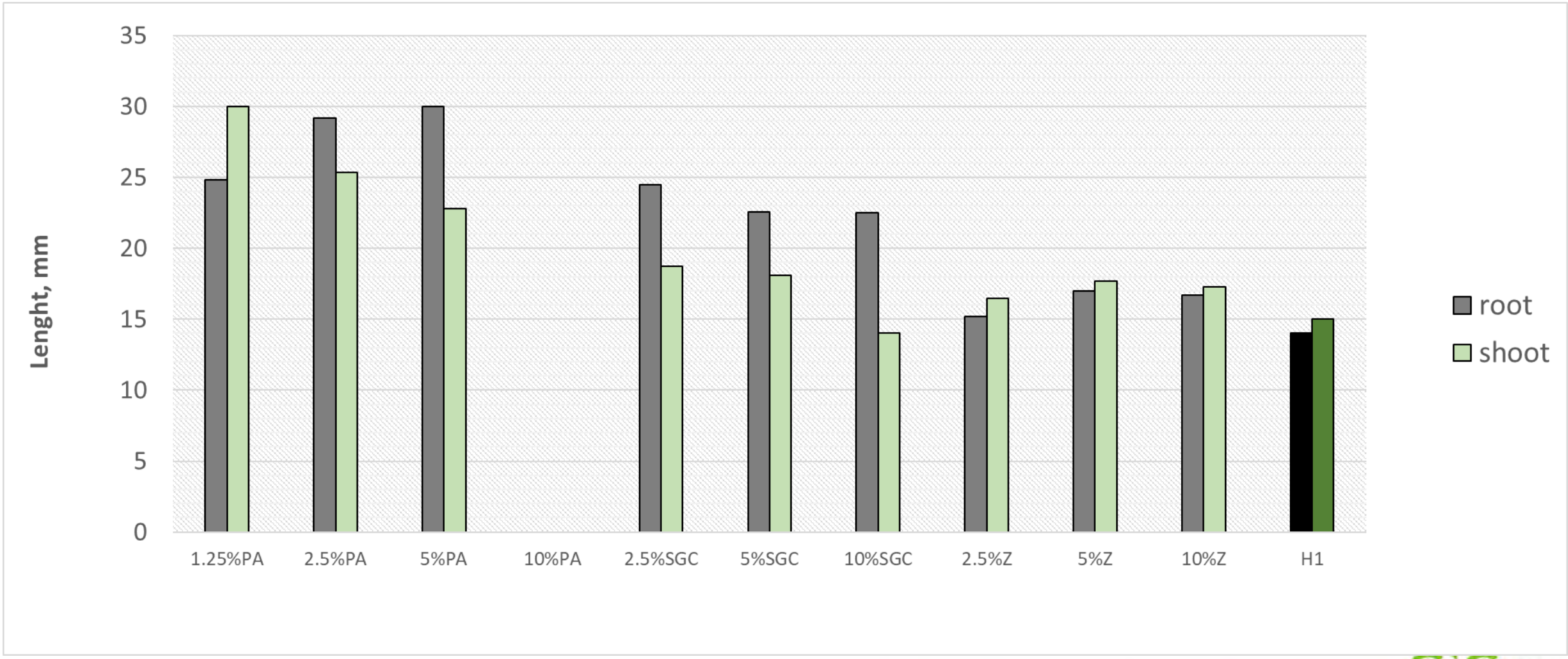
- **zeolite obtained from coal combustion ash**

[Adamczyk et. al. 2020, Król 2020, COALBYPRO]

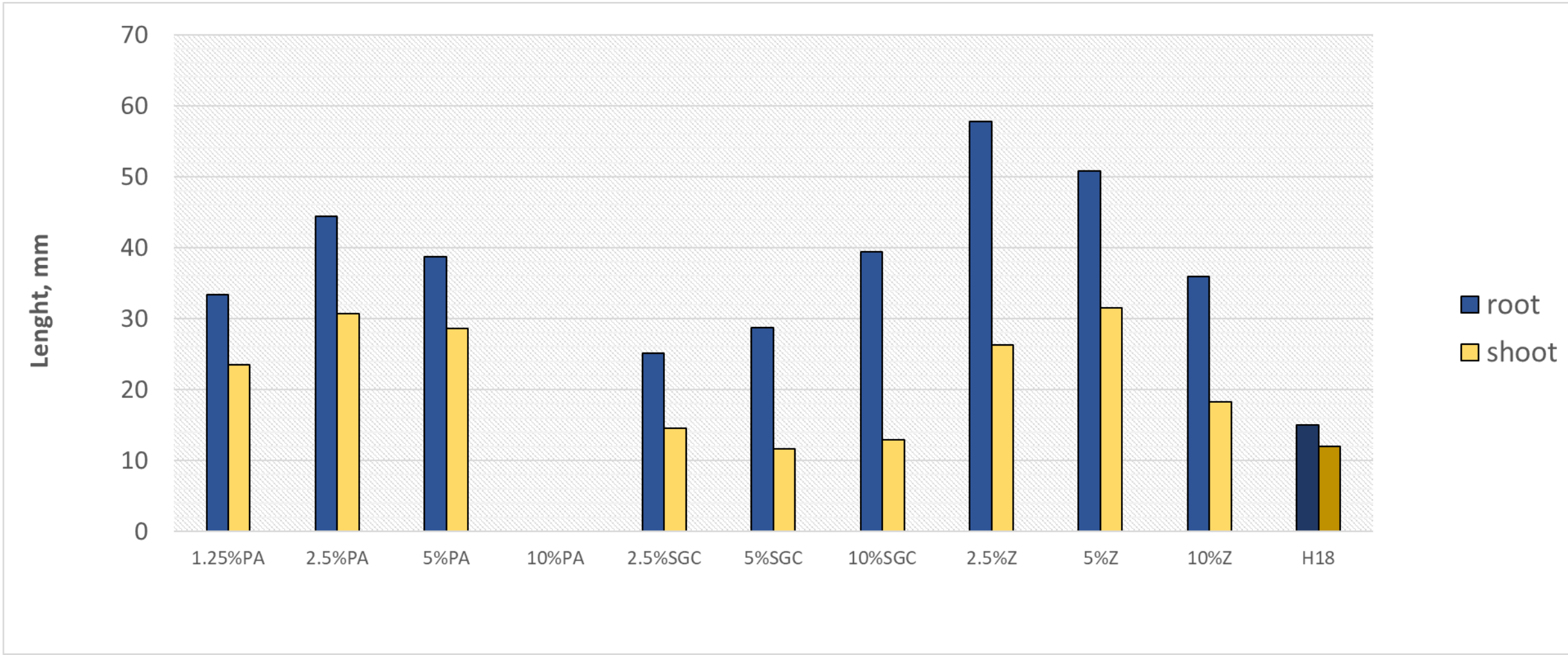


Adamczyk et al. 2020, Synthesis of Na-LSX type zeolite from Polish fly ash, Gospodarka surowcami mineralnymi – mineral resources management, 36, 5-30
Cempa et al. 2022, Ash from Poultry Manure Incineration as a Substitute for Phosphorus Fertiliser, Materials,
Ciesielczuk et al. 2017, Acute toxicity of experimental fertilizers made of blood meal, spent coffee ground and biomass ash, Journal of Water and Land Development, 34, 95-102
Lee et al. 2021 Impact of Coffee Ground on Ammonia Concertation, Open Science Journal, 6(4)
DEASPHOR project, Innovative management of COAL BY-PROducts leading also to CO_2 emissions reduction
COALBYPRO project, Design of a product for substitution of phosphate rocks

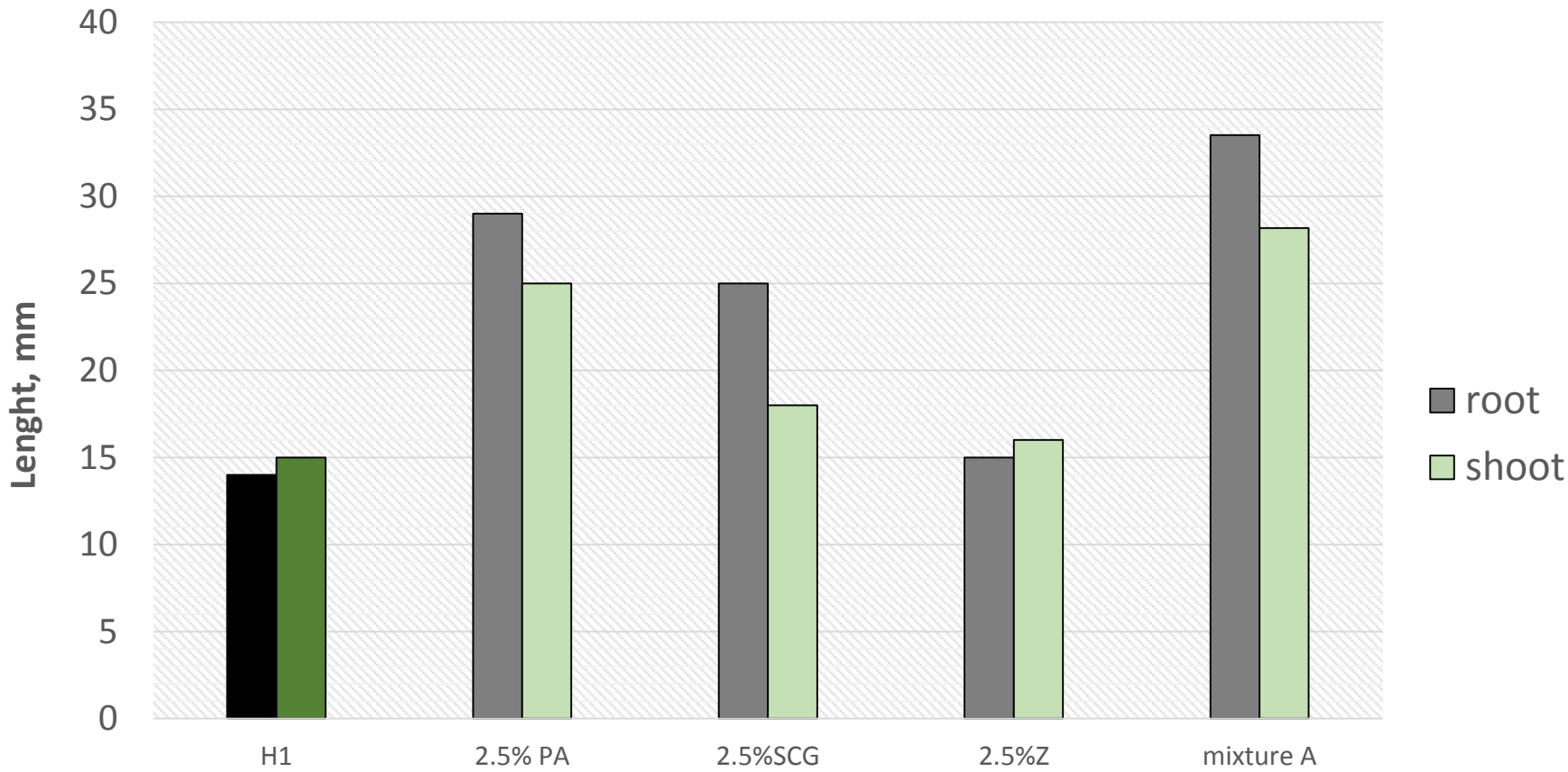
SAMPLE H1 + FERTILIZER ADDITION



SAMPLE H18 + FERTILIZER ADDITION

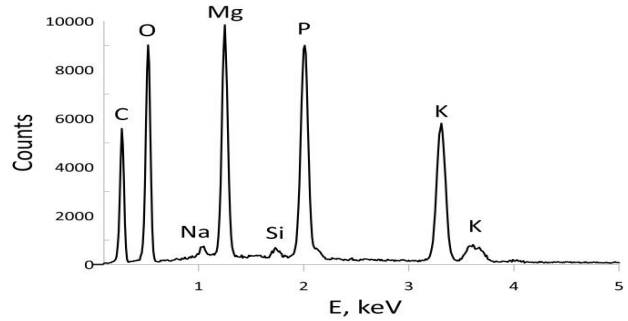


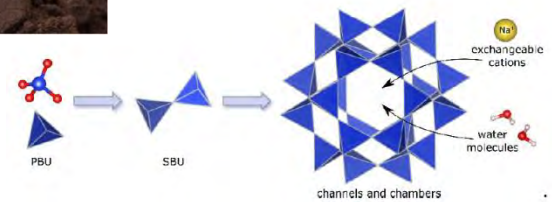
SAMPLE H1 + FERTILIZER MIXTURE



mixture A = 2,5%wt. PA + 2,5%wt. SCG + 2,5%Z + 92.5% H1

CONCLUSIONS





❑ Application of additives such as

- ash from poultry manure incineration,
- spent coffee ground,
- zeolite obtained from coal combustion ash

can improve plant growth on mine-waste substrate

❑ The optimal dose and type of fertilizer additive should be adjusted to the physicochemical properties of the mine-waste substrate

❑ Field cultivation it is key stage to fully confirm the fertilizing effectiveness of the developed mixtures based on waste from the poultry, coffee and energy industries

Thank you for your attention

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