THE APPLICABILITY OF RIVER SEDIMENT FOR THE PRODUCTION OF CLAY BRICKS

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INTRODUCTION

Each year approximately 30,000 m^3 of sediment accumulates in the Lake Ptuj from the hydro power plant. This sediment is currently being handled by conventional solutions of management, which entails either disposing the sludge in landfills or reintegrating the sediment into rivers or water-ecosystems. The beneficial uses of river sediment are becoming increasingly interesting in terms of environmental protection and sustainable development. Considering the composition of river sediment, and its continuous availability, the potential use of dredged sediments for brick production is highly promising.

The aim of the present study was to evaluate the sediment from the River Drava (Lake Ptuj) for its potential use in the clay brick sector, and to define to what extent it would be possible to replace virgin clay with sediment.

READY4USE – PROJECT IMPACT

- **Enhance utilization of river sediment**
- **Decrease the amount of waste sent to landfill**
- **Development of products with added value**
- **Contribute to industrial symbiosis and circular economy**

SAMPLING AND EXPERIMENTAL METHODS

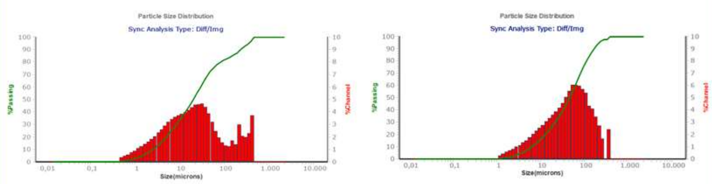
The raw materials used in this study were clay from a locally brick factory from Ormož; it is used in the brick manufacture, and dredged river Drava sediments from lake Ptuj bank. Coordinate of sediment sampling was GKY 568935 and GKX 139701. The depth of sampling was between 0.5 m and 1 m, and samples were stored in clean polyethylene bags (discharged air), remaining the natural hydration during the whole testing period.

Sediments were first analyzed to determine their chemical (by XRF), mineralogical (by XRD) compositions, and particle size distribution by sedimentation.
Mixtures composed of varying amounts of brick-making clay and sediment (in the ratio of: 0:100, 10:90, 20:80, 30:70, and 50:50, respectively) were then prepared on a laboratory vacuum extruder.

Extrusion of mixtures

The following properties were determined for clay and each clay/ sediment mixture:
(i) plasticity,
(ii) shrinkage during drying,
(iii) shrinkage and water absorption after firing,
(iv) density and mechanical properties after firing

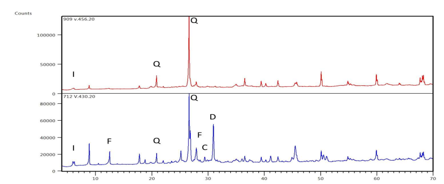
ANALYSIS OF SEDIMENT AND CLAY



Particle size distribution of brick-making clay (left) and sediment (right)

Chemical analysis of sediment and clay

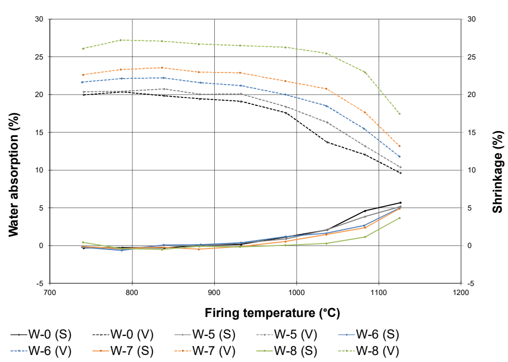
Composition (%)	Sediment	Clay
SiO_2	45.4	61.6
Al_2O_3	13.8	16.4
Fe_2O_3	6.1	6.7
CaO	7.9	0.5
MgO	4.9	0.9
Na_2O	1.4	0.8
K_2O	2.4	2.0
LOI	15.8	9.4



XRD analysis of brick-making clay (upper) and sediment (lower) with identified phases (I-illite, Q-quartz, F- feldspar, D-dolomite, C-calcite)

RESULTS

The analysis of the firing process in a gradient furnace provides information about linear shrinkage and water absorption as a function of the firing temperature and shows what is the trend in terms of shrinkage and water absorption over selected temperature range.



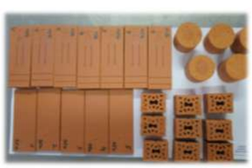
Water absorption and shrinkage upon firing temperature (results from gradient kiln)

Appearance of samples after firing in gradient kiln

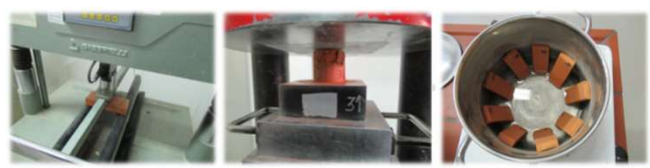
After extrusion drying shrinkage was measured, while after firing following test were performed: shrinkage, water absorption, density, bending strength, and compressive strength.

Properties of dried and fired samples (at 950 °C)

Sample	Sediment addition (%)	Drying shrinkage (%)	Firing shrinkage (%)	Density (g/cm³)	Water absorption (%)	Bending strength (MPa)	Compressive strength (MPa)
W0	0	8.5	1.3	1.76	17.2	11.2	33
W5	10	8.9	1.1	1.73	18.1	13.7	31
W6	20	9.2	0.6	1.69	19.9	13.6	35
W7	30	9.2	0.4	1.66	21.4	10.7	32
W8	50	9.2	0.0	1.52	25.1	7.1	25



Samples fired at 950 °C



Determination of bending strength, compressive strength and water absorption

CONCLUSIONS

The chemical and mineralogical compositions confirmed that sediment is of a suitable composition to be used in the clay-based sector, and that it contains at least 50% of clay. Particle size of the sediment was below 500 µm. It is therefore expected that a reasonably high amount of brick-making clay could be replaced by such sediment.

The addition of sediment to clay slightly increases shrinkage on drying, but reduces shrinkage on firing.

Only when 50% of sediment is added the mechanical properties are notably lowered; the compressive strength of brick-making clay after firing was 33 MPa, compared to 32 MPa when 30% of sediment was added, decreasing to 25 MPa when the mixture contained 50% sediment.

Laboratory results confirmed the potential of sediment to be directly used in the clay brick sector.

Next step is now planning of the industrial pilot production which will enable an evaluation of results from a technological point of view in real conditions.

REFERENCES

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MORE…

…about READY4USE project on webpage: *http://www.zag.si/si/projekti-zag/l7-2629*

ACKNOWLEDGMENT

The authors would like to thank the Slovenian Research Agency (ARRS) for project grant L7-2629: "Evaluation and remediation of sediments for further use in building sector (READY4USE)".