RawMaterials
Connecting matters

Funded by the European Union

ALiCE

Al-rich industrial residues for mineral binders in the ESEE region

The mail goal of RIS-ALiCE project **(http://ris-alice.zag.si/)** is creation of a network of relevant stakeholders in the area of currently unused and landfilled aluminum containing industrial residues and contribution to the increase of the innovation potential and competitiveness of the ESEE region. By interlinking local partners, valorizing residues for innovative mineral binder and creating an upgradeable online registry, we will help enhance sustainable mineral resource management in the ESEE region will be enhanced.

Newsletter gathers project achievements as a result of 3-year activities within the RIS-ALiCE project (March 2019-March 2022).

As disseminations of the project and networking activities present one of the most important parts of the RIS-ALiCE project, thus project was disseminated on various levels and at different events, such as:

Events organized by RIS-ALiCE project:

- **3 international workshops:** an online international workshop "Building the registry of Al rich secondary resources for the production of low carbon and low energy mineral binders within the RIS-ALiCE project" was organized by the Slovenian National Building and Civil Engineering Institute, Geological Survey of Slovenia, Salonit Anhovo d.d. and the Vinča Institute of Nuclear Sciences, Belgrade University; the Vinča Institute of Nuclear Sciences, Belgrade University and the Slovenian National Building and Civil Engineering Institute organized the international workshop "Recycling and environmental radioactivity of Al rich residues" and at the international workshop: "Registry of Secondary mineral resources for the production of low-carbon cements" organized by FTM-UKIM, ZAG and GeoZS;
- **13 national workshops:** in Slovenia, Serbia, Bosnia and Herzegovina, Hungary and North Macedonia were the workshops organized in order to promote the innovative approach of Al-rich residues recycling and to raise the awareness among the stakeholders (year 2019); and two years afterwards: in Hungary, BZN organized a webinar, where the results of the sampling and analytical measuring tasks of the project, and the current status of RIS-ALiCE database was presented by oral presentation. In Bosnia and Herzegovina, IKK partner presented RIS-ALiCE project and general overview of the innovative and sustainable mineral binders with a low CO_2 content in the cement industry. Serbian partner, VINS, during the national workshop presented to the industry and academia the goals of the RIS-ALiCE project, with the focus on the register of Al-containing residue in the EESE region. In North Macedonia, FTM-UKIM together with USJE and ESM presented the online registry on the national level and the perspectives for utilization of secondary raw materials in the future of Macedonian society. Slovenian partners, GeoZS, ZAG, Salonit Anhovo organized the national workshop, where available industrial residues and wastes, their potential application in the cement industry and promotion of the RIS-ALiCE register were presented, the staff from the Vinča Institute of Nuclear Sciences, Belgrade University in cooperation with the Scientific and Educational Centre for Children and Youth in Serbia presented the project to children and their parents; the project partner Bay Zoltan Nonprofit Ltd. organized an online workshop for Hungarian registry users to introduce the first version of the RIS-ALiCE registry and at Workshop for register users in Serbia organized by Vinča Institute of Nuclear Sciences, Belgrade University;
- **Training school:** the students online training school Al-rich industrial residues for inorganic materials hosted VINS, where participants from 9 countries took part in 27 online presentations (opening ceremony – 2 presentations; plenary lectures- 3; invited lectures- 14; student's presentations- 6 oral and 2 poster presentations;
- **1 congress:** at 14th Students' Congress of CTM was held in Skopje, North Macedonia at the Ss. Cyril and Methodius University in Skopje, Faculty of Technology and Metallurgy. The congress was co-organized by the RIS-ALiCE project;
- **2 conferences:** First student conference of young scientists and designers organized by FTM-UKIM (2020) and Final dissemination conference organized by Institute "Kemal Kapetanović" in Zenica, Bosnia and Herzegovina (hybrid in 2022);
- **co-organisation of scientific conferences:** EGU conference 2020, Section ERE 5.5 Sustainable mining and circular economy: waste characterization and exploitation supported by geophysical methods; EGU conference 2021, Section ERE 5.3 Sustainability as a challenge to face and a goal to reach: interdisciplinary approach to support raw materials and energy supply;
- **RIS Cluster Waste2Resource event:** In the year 2020 the project partners from the RIS -CURE, RIS-RECOVER, RIS-ALiCE, and RIS-RESTORE projects (all projects are funded by European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation) gathered together to link projects dealing with zero waste extraction to form a RIS cluster Waste2Resource; In the year 2021 the project partners from the RIS-CURE, RIS-ALiCE, INCO Piles, RIS-RESTORE projects gathered together to link projects dealing with zero-waste extraction to form a RIS cluster Waste2Resource. ZAG was co-organizing the online meeting of RIS cluster Waste2Resource and presented the RIS-ALiCE project;
- **8 site visits:** to producers and landfills of industrial by-products: slag processing plant (EAF C slag) in SIJ ACRONI company in Slovenia, Šoštanj Thermal Power Plant field in Slovenia (2019), cement plant USJE Cementarnica – TITAN Group in North Macedonia (2019), thermal power plant REK Bitola in North Macedonia (2019); Alumina d.o.o. Zvornik, Bosnia and Herzegovina (2019); EFT Mine and Thermal Power Plant Stanari, Bosnia and Herzegovina (2019); steel mill in SIJ Acroni company in Slovenia (2020), steel slag processing plant SIJ Metal Ravne in Slovenia (2020), students from FTM had the possibilities to visit the laboratory for cement control at the USJE Cementarnica – TITAN Group (2021);
- **seminars at partner institutions:** SIJ ACRONI, Slovenia (year 2019; 2020; 2022); ZAG, Slovenia (year 2019; 2020); GeoZS, Slovenia (year 2019; 2020); TU Wien, Austria (year 2020); BZN, Hungary (year 2020, 2022); Cementarnica USJE, North Macedonia (Year 2022); Salonit Anhovo, Slovenia (Year 2022).


National workshop at University of Zenica - Institute »Kemal Kapetanović« (BA).

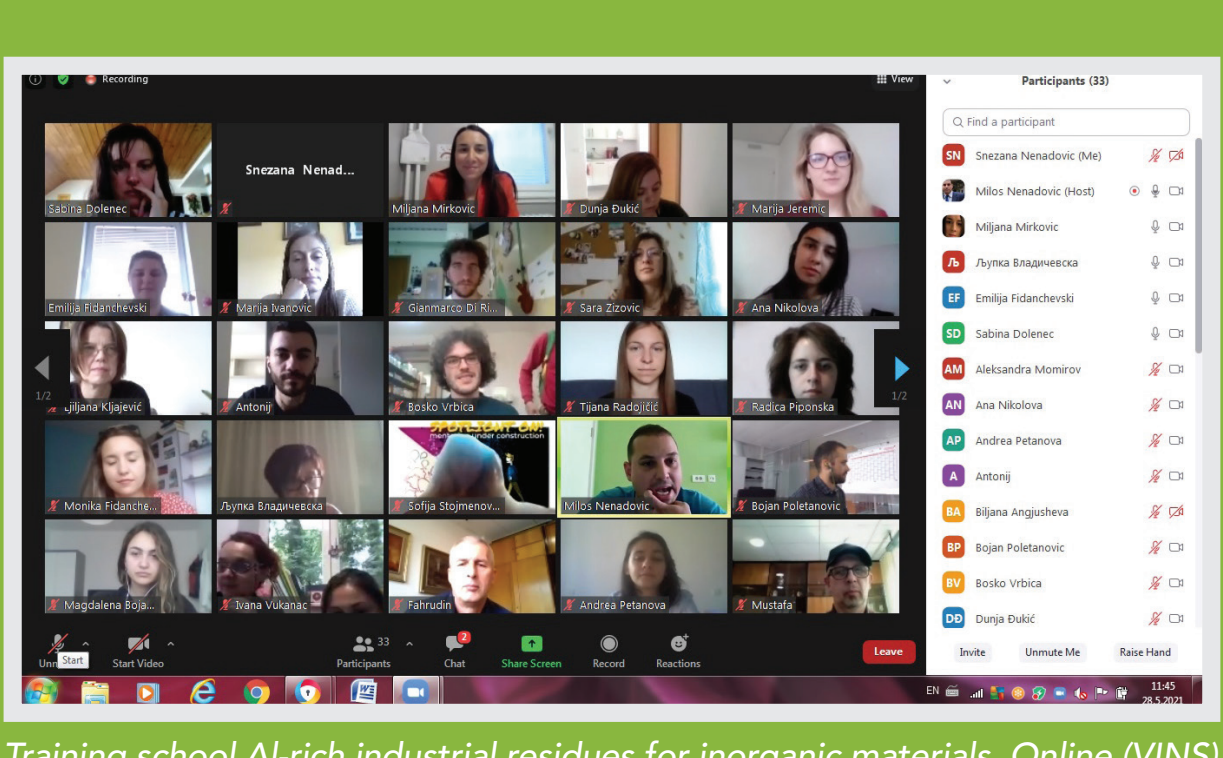

National workshop at Vinča Institute of Nuclear Sciences (RS).


Seminar at TU Wien (AT).


National workshop at Ss. Cyril and Methodius University in Skopje, Faculty of Technology and Metallurgy (MK).


Lectures to student at TU Wien (AT).


Site visit in SIJ Acroni (SI).


Training school Al-rich industrial residues for inorganic materials. Online (VINS)

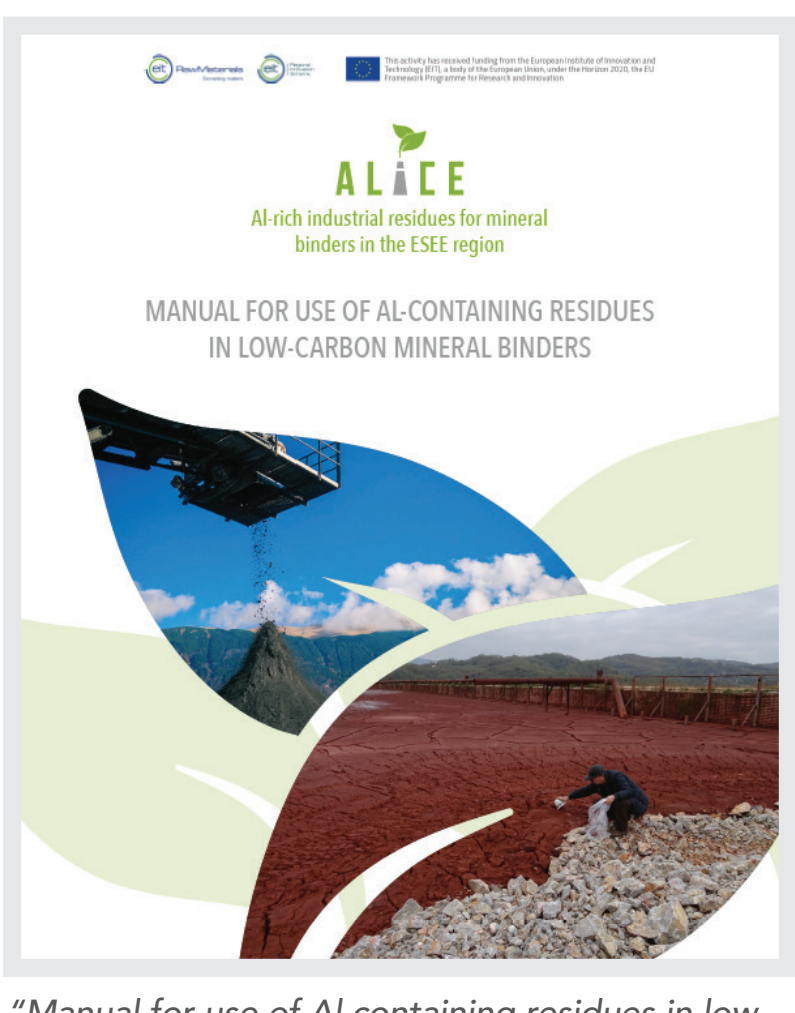

Site visit in Cementarnica USJE (MK).


Site visit in Alumina Ltd. Zvornik (BA).

Publications:

- **5 scientific papers:**
  - Žibret, L.; Šter, K.; Borštnar, M.; Loncnar, M.; Dolenec, S. The Incorporation of Steel Slag into Belite-Sulfoaluminate Cement Clinkers. Appllied Science, 2021, 11, 1840. https://doi.org/10.3390/app11041840;
  - Fidanchevski, E.; Angjusheva, B.; Jovanov, V. et al. Technical and radiological characterisation of fly ash and bottom ash from thermal power plant. Nuclear Technology and Radiation Protection, 2021, 330, 685–694. https://doi.org/10.1007/s10967-021-07980-w;
  - Žibret, G.; Teran, K.; Žibret, L.; Šter, K.; Dolenec, S. Building of the Al-containing Secondary Raw Materials Registry for the Production of Low CO_2 Mineral Binders in South-Eastern European Region. Sustainability 2021, 13, 3: 1535. https://doi.org/10.3390/su13031535;
  - Kljajević, M. L.; Mirković, M. M.; Dolenec, S.; Šter, K.; Hadžalić, M.; Vukanac, S. I. and Nenadović, T. M.; Radiological and Physico-Chemical Characterization of Red Mud as an Al-containing Precursor in Inorganic Binders for the Building Industry. Nuclear Technology and Radiation Protection, 2021, 36, 2, 182-191. https://doi.org/10.2298/NTRP2002182K;
  - Mirković M.; Kljajević L.; Dolenec S.; Nenadović M.; Pavlović V.; Rajačić M and Nenadović S., Potential Usage of Hybrid Polymers Binders Based on Fly Ash with the Addition of PVA with Satisfying Mechanical and Radiological Properties, Gels, 2021, 7, 270. https://doi.org/10.3390/gels7040270;
- **10 professional papers:**
  - Slovenian national journal Gradbenik (''Secondary mineral resources for the sustainable production of cement);
  - Slovenian professional journal Mineral & Gradnja (''New low-carbon and low-energy cements from by-products of industry and construction waste");
  - Slovenian journal Revija SIJ in March and May 2020 ("A lot of knowledge from different fields with common goals" and "A step towards sustainable development: the use of processed steel slag for BCSA clinker");
  - Slovenian professional journal Mineral & Gradnja ("Registry of Al-rich secondary raw materials with potential for use in the production of low-CO_2 cements");
  - Slovenian journal Naš list in September 2020 ("Slovenian Partnership for the Circular Economy");
  - Slovenian Magazine Geonovice in September 2020 ("The registry of Al rich secondary resources in ESE Europe – RIS-ALiCE");
  - Slovenian journal EOL in December 2020 (within the article "From words to the market is a long way, examples of optimism"; "Secondary mineral raw materials for decarburization of the cement industry").
- **1 popular paper:**
  - Slovenian journal Finance, the Okolje in energija supplement in June 2020 ("Thus they will reduce the carbon footprint in the cement industry").
- **"Manual for use of Al containing residues in low carbon mineral binders"** (available in print version and online at: http://www.zag.si/dl/manual- alice.pdf). This manual, prepared by the RIS-ALiCE team, addresses the legislative aspects governing the use of secondary raw materials in construction products, and contains a description of the most common Al containing industrial and mining residues (bauxite deposits, red mud, ferrous slag, ash and some other industrial by products), the potentiality for their reutilization and its economic aspects, potential requirements/barriers for the use of secondary raw materials in the cement industry, and a description of belite sulfoaluminate cements, which are a promising solution for implementing the circular economy through the use of large amounts of landfilled Al rich industrial residue and mining waste cement clinker raw mixture. This manual was prepared by the partners of the RIS-ALiCE project. It provides a popular content, which targets the relevant stakeholders as well as the wider society. Moreover, it offers educational material for undergraduate, master and PhD students.

Participation at different dissemination events:



"Manual for use of Al containing residues in low carbon mineral binders".

- **16 scientific conferences:** XII "Stone-Gravel Days" Annual Mining Conference in Velence in Hungary (oral presentation) • 51st International October Conference on Mining and Metallurgy in Bor in Serbia (poster and oral presentation) • 24th Consultation of Slovenian geologists in Ljubljana in Slovenia (poster presentation) • International Conference on the Management of Naturally Occurring Radioactive Materials NORM IX Conference, Denver, Colorado, USA (oral presentation) • 1st International Conference on Advance Production and Processing in Novi Sad, Serbia • VII Terrestrial Radioisotopes in Environment – International Conference on Environmental Protection (VII. TREICEP), Veszprém, Hungary • August 2020 (3 conference papers: "Radiological properties of fly ash as a raw material for low carbon cements", "Radiological assessment of red mud as an Al containing precursor in inorganic binders for the building industry", "Valorisation of Al containing mineral residues for sustainable inorganic binders") • BEFIB2020, Valencia, Spain, September 2020 (1 conference paper: "Influence of the Curing Temperatures on the Mechanical Properties of Hemp Fibre Reinforced Alkali Activated Mortars") • the European Geosciences Union (EGU) 2020, May 2020 (co-organization, presentation, Section ERE 5.5 Sustainable mining and circular economy: waste characterization and exploitation supported by geophysical methods • 1 conference paper: "Al rich industrial residues for mineral binders in ESEE region") • International Conference on the Management of Naturally Occurring Radioactive Materials (NORM) in Industry, Vienna, Austria, October 2020 (poster presentation: "Potential of coal fly ash in building materials") • at the Adria Innovation Days in Portorož in Slovenia (Regional Center Adria in cooperation with Chamber of Commerce Slovenia organized Adria Innovation Day 2019 with the title ''Innovation in primary secondary raw materials sector in the South-East Europe'') in 2019 • the first Student Conference of Young Scientists and Designers, Skopje, North Macedonia, October 2020 (an online conference, where the RIS-ALiCE promotion material was distributed among the participants) • 3rd International Conference on Technologies and Business Models for the Circular Economy (TBMCE 2020), December 2020 (an online conference; presentation of RIS-ALiCE project: Al rich industrial residues for mineral binders in the ESEE region) • Conference Construction Materials for a Sustainable Future, 2nd International Online Conference COMS (April 2021): K. Šter, P. Kesserű, I. Kovacs, M. Hadžalić, G. Žibret, K. Teran, S. Nenadović, A. Ipavec, S. Dolenec, "Valorisation of selected secondary raw materials for low CO_2 cements" • online Presentation in Showed room • Conference YUCOMAT (August/September): K. Šter, M. Borštnar, S. Dolenec, "Properties of belite-calcium sulfoaluminate cements synthesized from various industrial residues" • Conference EGU21: Gather Online (April 2021) co-organized Section ERE 5.3 Sustainability as a challenge to face and a goal to reach: interdisciplinary approach to support raw materials and energy supply" by ZAG (Sabina Dolenec) • S. Dolenec, K. Šter, K. Teran, A. Ipavec, M. Borštnar, L. Žibret, B. Kószó, S. Nenadović, N. Stamatovska Aluloska, I. Merta, R. Laucournet, G. Žibret, "Valorisation of mine and quarry waste in production of sustainable cements", at 25th Consultation of Slovenian geologists in Ljubljana in Slovenia (poster presentation) • at the Mineral Resources Expert Group Meeting in 2021, where GeoZS participated and presented the RIS-ALiCE project and registry;
- **presentations to more than 300 students:** during the seminars, at University of Ljubljana, Faculty of Natural Science and Engineering, Department of Geology, ZAG organized a Technical course for the students at 1st year of master studies, during lectures at TU Wien in Austria, at University of Kragujevac and University of Niš in Serbia, at University of Ljubljana in Slovenia, at Ss. Cyril and Methodius University in North Macedonia; at the Ss. Cyril and Methodius University in Skopje in North Macedonia (technical staff from cement factory USJE Cementarnica – TITAN Group organized a webinar "Towards Cements with Low CO_2 Emission" at the Faculty of Technology and Metallurgy and at the Faculty of Civil Engineering) and at the Institute "Kemal Kapetanović" in Zenica, Bosnia and Herzegovina;
- **1 summer school:** RAISE summer school hosted at Bay Zoltan for 5 high school pupils, where the pupils received an overview about the utilization and recycling of raw materials, and about the circular economy concept.
- **3 workshops:** at Faculty of Civil Engineering, University of Zagreb in Croatia (title of the workshop: Transformation of ash from wood biomass into value-added construction composites), at ZAG in Ljubljana, Slovenia (title of the workshop: 3D and 4D materials analysis with synchrotron analytics); at the workshop "Toward the successful valorization of Bauxite Residue: problems / challenges for the implementation of new solutions & value chain creation" organized by ZAG and National Technical University of Athens, as a part of the RIS-RESTORE project;
- **3 seminars:** "Application of Ionizing Irradiations in Nanotechnology for Environment, Energy and Health pourposes" (NANO IRRA NET- financed from IAEA), at FTM in North Macedonia; At the meeting participated people from academia and researches institutions and Ministry of Education and Science of North Macedonia and company representatives from North Macedonia and Belgium 2019; Geominuta organized by project partner GeoZS in year 2020 and 2021.
- **1 fair:** 59th Sejem Dom (Home Fair) in 2020, which took place in Ljubljana, Slovenia.


24th Consultation of Slovenian geologists in Ljubljana, (SI).


1st International Conference on Advance Production and Processing in Novi Sad, (RS).


Mineral Resources Expert Group Meeting (PT).


Adria Innovation Days, Portorož (SI).


International Conference on the Management of Naturally Occurring Radioactive Materials NORM IX Conference, Denver, Colorado, (USA).


The 51st International October Conference on Mining and Metallurgy (RS).

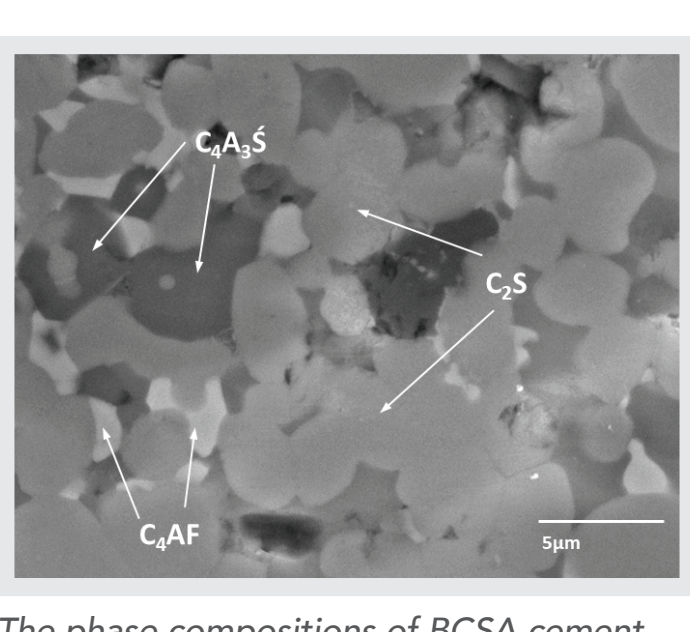
- **Posts on various social media:** Website in 2019 (BZN, TU Wien); 2 LinkedIn posts in 2020 (Lucis d.o.o.: Project: RIS-ALiCE and PROJECT UPDATE: RIS-ALiCE PLUS); 1 Facebook post in 2020 (the Geological Survey of Slovenia announced information about an article on the RIS-ALiCE project in the "Mineral & Gradnja" journal on their Facebook wall); 1 Facebook post in 2020 (the Faculty of Technology and Metallurgy announced the information after the webinar "Towards Cements with Low CO_2 Emission" realization on their Facebook wall); LinkedIn in 2021 (ZAG, FTM-UKIM), Twitter in 2021 (TU Wien) Instagram in 2021 (FTM-UKIM), Facebook (GeoZS), Website in 2021 (FTM-UKIM, USJE, Economic Chamber of North Macedonia).
- **Within the registry promotion:** more than 50 companies (associations) were contacted per E-Mail, with the request to register on the RIS-ALiCE online registry
- **In order to establish a network of relevant stakeholders** in the area of currently unused and landfilled Al-rich industrial residues the following **44 stakeholders** officially confirmed their **interest in the RIS-ALiCE project:**
  Faculty of Natural Sciences and Engineering, University of Ljubljana • Faculty of Energy, materials and physics, China University of Mining and Technology • SIJ Elektrode d.o.o., Ltd., Jesenice • University of Zagreb, Faculty of Science • KAMTEH GmbH, Podružnica Šmartno ob Paki • Inlecom innovation astiki mi kerdoskopiki etaireia • Aoks droup d.o.o. Skopje, North Macedonia • University "Ss Cyril and Methodius" Skopje Institute of Earthquake Engineering and Engineering Seismology • SUGS Georgi Dimitrov • Arcelor Mittal Zenica • Rudarski institut Prijedor d.o.o. • Kakanj cement plant • Alumina d.o.o. Zvornik • JP EP BiH TE Kakanj – Kakanj • PC of Electric Power of Serbia • Alumetal Group Hungary Kft. • Earth Science Department – University of Torino, Italy • LafargeHolcim – Geocycle, France • Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia • Termit d.d., Slovenia • MYTILINEOS S.A., Greece • Goriške opekarne d.o.o., Slovenia • Calcit d.o.o., Slovenia • SIJ Metal Ravne d.o.o., Slovenia • Faculty of Civil Engineering, University of Belgrade, Serbia • Faculty of Sciences and Mathematics, University of Belgrade, Serbia • Faculty for Technology and Metallurgy, University of Belgrade, Serbia • Faculty of Technical Sciences, University of Novi Sad, Serbia • Lead and Zinc Mine, GROT d.o.o., Serbia • MOL Plc, Hungary • Femalk, Hungary • Faculty for Computer Science and Engineering, Ss. Cyril and Methodius University in Skopje, North Macedonia • Radiation Safety Directorate, North Macedonia • Makstil AD Skopje, North Macedonia • Natron – Hayat d.o.o. Maglaj, Bosnia and Herzegovina • IPI Institut za privredni inženjering Zenica, Bosnia and Herzegovina • "Rudnici Boksita Jajce" d.d., Bosnia and Herzegovina • Lukavac Cement, Bosnia and Herzegovina • Martin Metals Kft • Envirotis Ltd • Brno University of Technology, Faculty of Civil Engineering • Institute of Physics of Materials of the Czech Academy of Sciences • Association of engineering societies Engineering Institution of Macedonia Skopje • Economic Chamber of North Macedonia

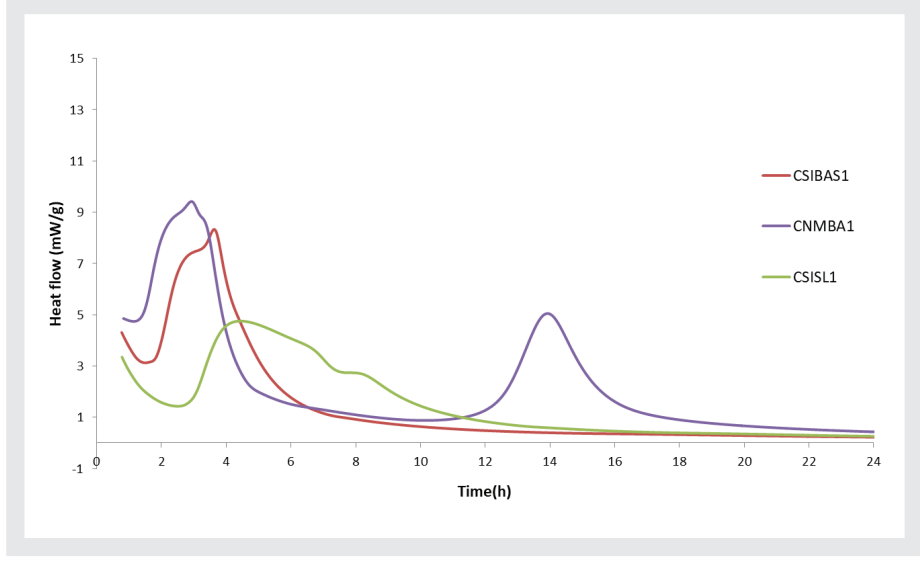
Mapping and assessment of Al-rich residues in ESEE region.

Available data on the alumina containing industrial and mine residues from ESEE countries with respect to their suitability for use in the low-CO_2 mineral binders were collected. For the purpose data on mining waste from bauxite and metal tailings, red mud, steel slag, fly ash and bottom ash from various industries and other types of waste based on previous studies have been collected in Slovenia, Hungary, Bosnia and Hercegovina, Serbia, North Macedonia and other ESEE countries. A total 39 samples were gathered within the project. Samples were characterized with respect to their mineralogical, chemical (main elements, trace elements, moisture content, mineral composition and presence of organic matter), physical (granulometry, BET specific surface area, specific weight bulk density) and radiological characteristics (content of radionuclides ^{40}K, ^{226}Ra and ^{232}Th). Various analytical methods were used: X-ray fluorescence spectroscopy, ICP optical emission spectrophotometry, X-ray powder diffraction, gamma spectroscopy, etc. As concerns the Al_2O_3 content of individual samples collected it varies from 1 wt. % in mine waste to 25wt. % in fly ash from thermal power plants, while low grade bauxite from Slovenia contained between 40 and 65 wt. % of Al_2O_3. Obtained information has served as an input data for the registry created within the project.

As regards LCA and LCCA analysis activities included communicating with partners and collecting data about their production lines, final products and residues. Further on LCA has been applied to identify the environmental impacts as well as cost efficiencies of different Al-containing waste materials applied in cement clinker production. LCA was used in order to assess the environmental impacts related to the use of different options of secondary raw materials related to the production of cement clinker (ashes, slags, red mud, and mine waste). To find the most suitable residue for cement clinker production with respect to particular cement plant in the region from an environmental point of view as well as cost efficiency, different potential scenarios have been studied. Moreover, benefits related to the utilization of waste as a substitution of natural, virgin materials, as well as benefits related with avoided landfilling of solid waste materials, were evaluated, applying consequential LCA approach. Part of this task was also LCCA with the main focus to identify costs, revenues and profits differences between the secondary raw materials used. The costs can vary in terms of estimating costs of waste recycling options. There are methodological challenges regarding applying discounting, which will be addressed in the project. Indeed LCCA can be an effective economic analysis efficiently applied also in selection of alternatives that affect future investments. Relevant data will be put in the registry.

Based on chemical characteristics of residues identified within the project, some of them were selected for the synthesis of belite-calcium sulfoaluminate cement clinker (BCSA), where certain amounts of natural raw materials were replaced with different secondary raw materials. By adding industrial residues to the raw mixture, bauxite - a limited and often expensive source of aluminium - was also replaced, either partially or completely. Cement clinkers with a targeted phase composition of 65 wt. % belite (C_2S), 20 wt. % calcium sulfoaluminate ($C_4A_3\bar{S}$) and 10 wt. % ferrite (C_4AF) were synthesized. Industrial mineral residues from alumina plants, thermal power plants, the paper industry, steel plants, and mining activities were considered for the study. Depending on the chemical composition of the residues, lower or higher amounts were allowed to be incorporated in the clinker raw meal producing the clinker with targeted phase composition: red mud 1-2 wt. %, slag 2-37 wt. %, fly ash 9-27 wt. %, bottom ash 10-58 wt. %, low grade bauxite 4-8 wt. %, mine waste 11-43 wt. % and other types of samples in the range 2-20 wt. %. The phase composition and microstructure of cement clinkers was studied by X-ray powder diffraction and the Rietveld method, and scanning electron microscopy with energy dispersive spectrometry (Figure 1). Furthermore, the hydration kinetics and compressive strength of cements at 7 and 28 days was also investigated.


The phase compositions of BCSA cement clinkers with marked belite (C_2S), calcium sulfoaluminate ($C_4A_3\bar{S}$) and ferrite (C_4AF). SEM / BSE microphotograph.


Hydration kinetics of BCSA cements from clinker with incorporated bottom ash.

Activities also included preparation of large-scale production of BCSA cement sample with incorporated bottom ash from thermal power plant in Slovenia. The preparation of BCSA cement clinker was upscale in a laboratory rotary tube furnace.


Synthesis of BCSA cement clinker in rotary tube furnace.

We also performed map-based analyzes that locate cement plants that can use secondary crude minerals and Al-residue sources identified in the first part of the project. Some valorization paths can be therefore defined with a distance calculation between providers and users. Then, the distance of transportation can be converted into CO_2 emission according to the environmental impact of analysis (LCA) to validate the positive balance of CO_2 between the gain obtained by producing BCSA based cement versus OPC and the emission due to the transportation of Al-rich residue. This environmental analysis has shown that there is no restriction at environmental level to valorize Al-rich residue into BCSA clinker even at long distance. The next step was regard the economic analysis by considering mostly the transportation cost of Al-residues to the cement plant for the valorization, which is most likely the main limit.

Online registry of secondary mineral raw materials

Registry of secondary raw materials in the ESEE region was developed within the project. In 2021, the registry was populated with data collected during the RIS-ALiCE project and data provided by external partners. The data in the register cover various characteristics of the secondary raw materials – including information about the owner, legal status, location of the material and its quantities, chemical, mineralogical and radiological properties of the material, etc. LCA analyses are also available for some of the materials. The registry has been promoted extensively among potential stakeholders at various national workshops, conferences, and events in the ESEE region, as well as disseminated through social media, professional publications, and scientific papers.

32 different companies have created a profile in the RIS-ALiCE registry and assigned 55 registered users. At the end of 2021, the registry contained 26 records, containing data about fly ash, bottom ash, steel slag, red mud, mine spoils, mineral raw materials, construction waste and other types of secondary raw materials in 4 different countries (Bosnia and Herzegovina, Hungary, North Macedonia and Slovenia).

In 2021, the functions of the RIS-ALiCE registry were thoroughly tested and feedback was obtained from the registry's users. The registry was updated based on these tests and user observations and prepared to be officially launched in the ESEE region.

The developed RIS-ALiCE **Registry of secondary mineral raw materials** (industrial and mine waste/by-products) serves as a "marketplace" for reviewing the quantity, availability and composition of individual secondary raw materials, thus enabling better connections between providers and potential users of secondary raw materials.. Users of secondary raw materials, such as cement plants, have already discovered its potential, which allows them to connect with suppliers of secondary raw materials from various industries suitable for their cement production. We invite you (especially waste holders/producers) to visit **https://alice-registry.eu/** and use the registry to share your data on secondary raw materials.

RIS-ALiCE Registry home page (https://alice-registry.eu/).


RIS-ALiCE Registy map browser.

ESM • bay • ceatech • GeoZS Geološki zavod Slovenije • LUCIS • sij acroni • TU WIEN • TITAN Cementarnica USJE • ZAG • AGREGO HALAS • SALONIT ANHOVO • TES Termoelektrarna Šoštanj