



Special issue on construction aggregates

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Introduction

Construction aggregates deserve special attention not only as the most voluminous mineral raw material extracted and utilised by humans, but also as one of the essential materials supporting development and functioning of the basic infrastructure of our civilization. To extend our understanding of the role of constructional geomaterials (including aggregates) and on how geologists can contribute to their study, series of conferences focused on constructional geomaterials including aggregates since 2001 (Table 1). Since the very beginning, organizers of these scientific meetings tried to preserve several characteristic features: informal spirit balanced with high scientific standard, open space to any nationality and level of scientific carrier (students, early-career scientists have been welcome all the time), and trial to provide space for high-quality publications submitted to fair peer-review process in well-established scientific journal or book series under the most important publishing houses. Besides this, all the work in the organization of meetings or conference sessions was (and is) kept strictly informal and volunteer, to promote its enthusiastic character.

During the past 20 years, these international scientific gatherings allowed to exchange novel ideas between thousands of scientists worldwide. Along with these fruitful meetings, 6 journal special issues (Table 2) covering specific topics of constructional geomaterials have been released (including the current one). Besides these journal volumes, another 7 books under the editorial role of the author of this contribution were realised (Table 3), and another book is under preparation.

The current special issue of the Bulletin of Engineering Geology and the Environment has a very special position and focus compared to the previous ones. In reality, it is the

first special issue of our informal initiative on Constructional GeoMaterials focusing only on aggregates in construction. This special issue contains 10 papers, most of which have been presented during the meetings since 2016. All the papers address important topics related to the current study of aggregates in construction.

Aggregates in construction

General issues

Aggregates are essential granular materials used in civil engineering; at the same time they make the most voluminous material extracted by humans from the lithosphere (Přikryl 2021). The role of aggregates in modern society desires much more appreciation also from the scientific community (Přikryl 2021). Although civil engineers rely on certain standardized properties of aggregates, these are tightly related to the genesis of source rocks, their mineralogical and geochemical composition, rock fabric and postgenetic development, i.e. properties which are sometimes omitted during the interpretation of their properties. As extraction of aggregates is linked to some environmental problems, sustainability of the whole aggregate industry is questioned as well (Přikryl 2021).

Standardization of the test methods for various aggregates used in diverse application is a major issue raised during recent decades. However, application of international standards — such as European ones — can have some limitation along with numerous advantages. Disability to cover all differences resulting from local/regional/national conditions can make serious problems when trying to use some specific types of aggregates. This question has been highlighted in the current special issue by Fladvad and Ulvik (2019) by discussing the issue related to sampling, testing and usage of large-size aggregates (i.e. above 90 mm in diameter). Fladvad and Ulvik's (2019) argument is that some of the conventionally advised test procedures are not adoptable for these large-size aggregates which implies application of

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Table 1 Overview of previous conferences and scientific meetings on constructional geomaterials with the organizing input from the editor of this special issue

Year	Conference, session	Location	Organizer/convenor	Conference/session topic
2001	SWAPNET 2001	Prachovské skály, Czech Republic	Příkryl R., Viles H.A	Stone Weathering and Atmospheric Pollution NETWORK
2002	Lux et Lapis	Valtice, Czech Republic	Siegl P., Příkryl R	Stone in cultural landscape
2004	DIMENSION STONE 2004	Prague, Czech Republic	Příkryl R	New perspectives for a traditional building material
2005	EGU, YGP25	Vienna, Austria	Příkryl R., Smith B	Natural stone in monuments — from diagnosis to conservation
2006	EGU, ERE10	Vienna, Austria	Příkryl R., Török Á	Natural stone resources for historical monuments
2007	EGU, ERE7	Vienna, Austria	Příkryl R., Török Á	Natural stone resources for historical monuments
2007	EGU, ERE8	Vienna, Austria	Příkryl R., Török Á., Miskovsky K	Aggregates — the most widely used geological material
2008	EGU, ERE10	Vienna, Austria	Příkryl R., Török Á	Natural stone resources for historical monuments
2008	EGU, ERE11	Vienna, Austria	Příkryl R., Török Á., Miskovsky K	Aggregates — the most widely used geological material
2010	XX IMA, AM8	Budapest, Hungary	Török Á., Příkryl R	Mineralogical aspects of monument preservation
2010	XIX CBGA, S24	Thessaloniki, Greece	Török Á., Theodoridou M., Příkryl R	Natural stones, usage and testing
2011	EGU, ERE5.3	Vienna, Austria	Příkryl R., Gomez-Heras M., Török Á	Sustainability of traditional construction materials in modern society
2012	EGU, ERE3.3	Vienna, Austria	Příkryl R., Gomez-Heras M., Török Á	Traditional construction materials and monuments in modern society: present day threats and sustainable management
2013	EGU, ERE3.3	Vienna, Austria	Příkryl R., Gomez-Heras M., Török Á	Sustainability of traditional construction materials in modern society
2013	XII SGA Biennial Meeting, S6.2	Uppsala, Sweden	Příkryl R., Miskovsky K	Construction materials
2014	EGU, ERE3.3	Vienna, Austria	Příkryl R., Theodoridou M	Challenges to supply and quality of geomaterials used in construction
2014	XII IAEG, S5.1	Torino, Italy	Příkryl R., Török Á	Aggregates — the most widely used raw material
2014	XII IAEG, S8.12	Torino, Italy	Török Á., Příkryl R., Gomez-Heras M	Weathering and preservation of building stones and other materials
2014	XX CBGA, SS19	Tirana, Albania	Török Á., Theodoridou M., Příkryl R	Stones and construction materials: urban use and deterioration
2015	EGU, ERE6.2	Vienna, Austria	Příkryl R., Theodoridou M., Gomez-Heras M., Török Á	Challenges to supply, quality and durability of geomaterials used in construction
2016	EGU, ERE6.3	Vienna, Austria	Příkryl R., Török Á., Gomez-Heras M., Theodoridou M	Geomaterials in construction: resources, properties, performance, and environmental interactions
2017	EGU, ERE6.1	Vienna, Austria	Příkryl R., Török Á., Gomez-Heras M., Theodoridou M., Sass O., Dino G.A., Danielsen S.W., Careddu N	Geomaterials in construction: resources, properties, performance, environmental interactions, decay, and extractive industries waste management
2017	Natural stone for cultural heritage	Prague, Czech Republic	Příkryl R	Natural stone for cultural heritage: local resources with global impact

Table 1 (continued)

Year	Conference, session	Location	Organizer/convenor	Conference/session topic
2018	EGU, ERE7.1	Vienna, Austria	Přikryl R., Török Á., Gomez-Heras M., Theodoridou M., Sass O., Dino G.A., Careddu N., Danielsen S.W	Geomaterials in construction: resources, properties, performance, environmental interactions, decay, and extractive industries waste management
2019	EGU, ERE7.1	Vienna, Austria	Přikryl R., Theodoridou M., Török Á	Geomaterials in construction: resources, properties, performance, environmental interactions, and decay
2020*	EGU, ERE5.1	Vienna, Austria	Přikryl R., Germinario L., Török Á	Constructional GeoMaterials: Resources, Properties, Uses, and Environmental Interactions

EGU European Geosciences Union, General Assembly, IMA General Meeting of the International Mineralogical Association, CBGA Congress of the Balkan Geological Association, SGA Society for Geology Applied to Mineral Deposits

* The meeting was held only partly in on-line mode due to restrictions associated with COVID-pandemic; conference/session topic in bold = significant/prevailing number of contributions covering various aspects of construction aggregates, the coverage of aggregate-related issues on other meetings in the list was less significant

methodological creativity combined with specific national knowledge, such as Norwegian in this case.

Mechanical performance of aggregates

Resistance to external loads of various natures is one of the fundamental desirable properties of aggregates either in unbound or in bound states. As shown in the extensive review by Přikryl (2021), several authors came to rather variable views on mutual relationship between rock mechanical properties (mostly compressive strength) and their technological-mechanical performance (expressed by various empirical tests such as Los Angeles attrition value, Aggregate Crushing Value, Aggregate Impact Value, and/or micro-Deval test). Czinder and Török (2020) tested the relationship between compressive strength and micro-Deval value for various andesite rocks, concluding that sound exponential correlation exists for these variables.

The mechanical behaviour of aggregates is significantly influenced by their shape. In the case of coarser particles, CT scanning of gravel-sized particles allows for better recognition of their role and movement during triaxial testing (Zhang et al. 2019).

Soundness of aggregates and their composition

About half of the aggregates are used in bound state, mostly in hydraulic cement concrete (Přikryl 2021). As the aggregates make up to 80 vol% in concrete, they significantly influence its properties including durability. As shown on the example of crushed stone fine aggregates from ophiolitic formations in Cyprus (Fournari et al. 2021), rock mineralogical composition together with its postgenetic history and physical properties significantly influences the quality of resulting concrete and/or mortar. Detailed mineralogical-petrographical investigation thus should make the basis of the evaluation of any aggregate (Fournari et al. 2021).

Soundness of aggregate source rock is conventionally evaluated by a series of test methods including resistance to salt crystallization and/or technological-mechanical performance. Czinder and Török (2019) examined the behaviour of andesite aggregate in a prolonged salt crystallization test and influence of related microstructural changes on technological-mechanical performance. Based on their results, an increasing number of salt crystallization tests do not necessarily deteriorate the mechanical response of the tested aggregates (Czinder and Török 2019).

Extending knowledge on alkali-silica reactivity

Sound understanding of mineralogical and geochemical factors on the development of alkali-silica reaction is one of the most effective approaches on how to mitigate its occurrence

Table 2 Overview of journal special issues and edited book publications based on previous conferences and scientific meetings on constructional geomaterials

Year	Journal	Topic of special issue	Special issue guest editors
2010	Engineering Geology	Natural stones for historical monuments, testing, durability and provenance	Török Á., Přikryl R
2017	Bulletin of Engineering Geology and the Environment	Challenges to supply and quality of geomaterials used in construction	Přikryl R
2017	Environmental Earth Science	Geomaterial used as construction raw materials and their environmental interactions	Přikryl R., Török Á., Theodoridou M., Gomez-Heras M
2018	Resource Policy	Raw materials associated with extractive industry	Careddu N., Dino G. A., Danielsen S. W., Přikryl R
2021	Minerals	Minerals and other phases in Constructional Geomaterials	Přikryl R., Török Á
2021	Bulletin of Engineering Geology and the Environment	Aggregates (<i>current issue</i>)	Přikryl R

in concrete. Medeiros et al. (2020) have shown how modern techniques such as electron probe microscope can help in the discrimination of reactive/non-reactive volcanic rocks from precise measurement of volcanic glass composition.

Laboratory testing of the aggregate's alkali-silica reactivity by various accelerated methods became the most popular approach on the evaluation of rock susceptibility to this deleterious chemical reaction. Recently, rapid to ultrarapid test methods by using mortar bars subjected to high temperatures of about 80 °C are replaced by a slower concrete prism test at lower temperatures of 38 or 60 °C (Marfil et al. 2019). Mutual correlation of likelihood of alkali-silica reactivity obtained by these methods is rather controversial; however, a slower concrete prism test at lower temperature proves better results and sound correlation to the content of microcrystalline silica (Marfil et al. 2019).

Moreover, interpretation of physical changes of concrete test specimens related to development of alkali-silica-reactivity in laboratory conditions deserves more attention than just simple measurement of length changes. Recording of changes in dynamic elastic properties seems to be a very effective non-destructive measure of degree of damage and tightly correlates with length changes (Lokajíček et al. 2021).

Despite numerous difficulties related to realistic replication of alkali-silica reactivity in laboratory conditions, some approaches such as microwave radiation allow for its rapid occurrence as shown by Doria and Barreto (2021). Development of rapid activation of alkali-silica reaction is extremely important specifically due to the search for appropriate methods of its mitigation (Doria and Barreto 2021).

Table 3 Overview of edited book publications based on previous conferences and scientific meetings on constructional geomaterials

Year	Publisher	Book title	Book guest editors
2002	Karolinum	Understanding and managing stone decay	Přikryl R., Viles H
2004	A.A. Balkema Publishers	Dimension stone. New perspectives for a traditional building material	Přikryl R
2017	Karolinum	Architectural and sculptural stone in cultural landscape	Přikryl R., Siegl P
2007	Geological Society, London, Special Publications	Building Stone Decay: From Diagnosis to Conservation	Přikryl R., Smith B. J
2010	Springer	Materials, Technologies and Practice in Historic Heritage Structures	Boştenaru M., Přikryl R., Török Á
2010	Geological Society, London, Special Publications	Natural stone resources for historical monuments	Přikryl R
2016	Geological Society, London, Special Publications	Sustainable use of traditional geomaterials in construction practice	Přikryl R., Török Á., Gómez-Heras M., Miskovsky K., Theodoridou M

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