

WORKSHOP PROGRAM AND ABSTRACTS

Recovery Potential of Construction and Demolition Waste

**21-22 March 2019
Belgian Building Research Institute (BBRI)
Brussels**

Organized by
Mohamed Osmani, Ulrich Kral, Paola Villoria Sáez and Jeroen Vrijders under the
COST Action “Mining the European Anthroposphere”
www.minea-network.eu

Content

Workshop Program	3
Biographies	5
Berends, Chiel [European Commission, Brussels]	5
D’Hooghe, Johan [The European Demolition Association, Brussels]	5
Ehlert, Christina [Luxembourg Institute of Science and Technology, Luxemburg]	5
Galan, Berta [University of Cantabria, Spain]	5
Gobbo, Emilei [Université catholique de Louvain, Belgium]	6
Heidrich, Oliver [Newcastle University, United Kingdom]	6
Hobbs, Gilli [Building Research Establishment, United Kingdom]	6
Koostra, Lucinda [TNO, Netherlands]	7
Kral, Ulrich [Technische Universität Wien, Austria]	7
Osmani, Mohamed [Loughborough University, United Kingdom]	7
Piña Ramírez, Carolina [Universidad Politécnica de Madrid, Spain]	7
Romnée, Ambroise [The Belgian Building Research Institute, Brussels]	8
Tekin, Hamdi [Istanbul Arel University, Turkey]	8
Vanden Eynde, Annelies [Tracimat, Brussels]	8
Vegas, Iñigo [Tecnalia, Spain]	8
Ventura, Anne [IFSTTAR, France]	9
Villoria Sáez, Paola [Universidad Politécnica de Madrid, Spain]	9
Vrijders, Jeroen [Belgian Building Research Institute, Belgium]	9
Weimann, Karin [BAM Federal Institute for Materials Research and Testing, Germany]	9
Abstracts	11
The revised Waste Framework Directive: implications for C&DW and future policy trends	11
Recovery potential of demolition waste: The sky is the limit!	12
Buildings as material banks (H2020 project: BAMB)	13
Innovative approaches to C&DW management in Belgium	14
Traceability and quality management of C&DW	15
Assessment of construction and demolition waste recycling facilities’ performance	16
Usage of C&DW for ground improvement: a case study from Turkey	17
Cement mortars reinforced with mineral fibers from C&DW	18
Gypsum plasterboard recycling	19
Energy retrofit and material	20
Connecting the supply and demand of secondary building materials: estimating the environmental impact of reprocessing technologies for façades and roofs	21
Environmental assessment of Cement Concrete Demolition Waste recycling at regional scale combining LCA, MFA and a local economic market model	22
Managing construction resources in Europe and emerging economies: raw materials and disposal of cement and concrete in the UK and Thailand	23

Workshop Program

Day 1: Thursday 21st March 2019

9:00	REGISTRATION
9:30	OPENING AND INTRODUCTION
09:30	Welcome and workshop overview Mohamed Osmani (Loughborough University, UK)
09:40	COST Action CA15115: Mining the European Anthroposphere (MINEA) Ulrich Kral (Vienna University of Technology, Austria)
10:00	PLENARY PRESENTATIONS
10:00	The revised Waste Framework Directive: implications for C&DW and future policy trends Chiel Berends (The European Commission, Directorate-General for Environment)
10:20	Recovery potential of demolition waste: The sky is the limit! Johan D'Hooghe (The European Demolition Association)
10:50	COFFEE BREAK
11:05	H2020 PROJECTS
10:35	Advanced solutions fostering circular economy of end of life building materials (H2020 projects: HISER and VEEP) Iñigo Vegas (Tecnalia, Spain)
11:05	Buildings as material banks (H2020 project: BAMB) Gilli Hobbs (Building Research Establishment, UK)
11:35	CASE STUDIES
11:35	Innovative approaches to C&DW management in Belgium Jeroen Vrijders and Ambroise Romnee (The Belgian Building Research Institute)
12:05	Traceability and quality management of C&DW Annelies Vanden Eynde and Liesbet Van Cauwenberghe (Tracimat, Belgium)
12:35	LUNCH
13:35	BREAKOUT SESSION
	Topic 1: CURRENT status of C&DW recovery Facilitator: Christina Ehlert (Luxembourg Institute of Science and Technology, Luxembourg)
	Topic 2: FUTURE prospects of C&DW recovery Facilitator: Paola Villoria Sáez (Universidad Politécnica de Madrid, Spain)
14:35	Plenary: synthesis of topic 1 and 2 sessions Facilitator: Mohamed Osmani (Loughborough University, UK)
15:05	COFFEE BREAK
15:20	DEBATE: ROUTE MAP for the potential C&DW recovery to inform a knowledge base for material reserves and resources in the EU Facilitator: Mohamed Osmani (Loughborough University, UK)
	Facilitator: Mohamed Osmani (Loughborough University, UK) Panel members: Johan D'Hooghe (The European Demolition Association); Ambroise Romnée (The Belgian Building Research Institute); Liesbet Van Cauwenberghe (Tracimat, Belgium); Iñigo Vegas (Tecnalia); Gilli Hobbs (Building Research Establishment).
16:20	CLOSE OF DAY 1 ACTIVITIES

Day 2: Friday 22nd March 2019

9:00	WELCOME AND DAY 2 PROGRAMME
Overview of Day 2 workshop activities Mohamed Osmani (Loughborough University, UK)	
9:10	ORAL PRESENTATIONS: SESSION 1_C&DW recovery case studies Chair: Paola Villoria Sáez (Universidad Politécnica de Madrid, Spain)
9:10	Assessment of construction and demolition waste recycling facilities' performance Berta Galan (University of Cantabria, Spain)
9:30	Usage of C&DW for ground improvement: a case study from Turkey Hamdi Tekin (Istanbul Arel University, Turkey)
9:50	Cement mortars reinforced with mineral fibers from C&DW Carolina Piña Ramírez (Universidad Politécnica de Madrid, Spain)
10:10	Gypsum plasterboard recycling Karin Weimann (BAM Federal Institute for Materials Research and Testing, Germany)
10:30	COFFEE BREAK
10:45	ORAL PRESENTATIONS: SESSION 2_C&DW recovery methods and tools Chair: Christina Ehler (Luxembourg Institute of Science and Technology, Luxembourg)
10:45	Energy retrofit and material flows Emilei Gobbo (Université catholique de Louvain, Belgium)
11:05	Connecting the supply and demand of secondary building materials: estimating the environmental impact of reprocessing technologies for façades and roofs Lucinda Kootstra (TNO, Netherlands)
11:25	Environmental assessment of Cement Concrete Demolition Waste recycling at regional scale combining LCA, MFA and a local economic market model Anne Ventura (IFSTTAR, France)
11:45	Managing construction resources in Europe and emerging economies: raw materials and disposal of cement and concrete in the UK and Thailand Oliver Heidrich (Newcastle University, UK)
12:05	WORKSHOP CLOSING REMARKS AND COST Action CA15115 (MINEA) NEXT STAGES
12:15	LUNCH

Biographies

(in alphabetical order without titles)

Berends, Chiel [European Commission, Brussels]

Chiel Berends works for the Waste Management and Secondary Materials unit within the Directorate-General for Environment of the European Commission. Within this unit he contributes to EU policy in the area of construction and demolition waste, textiles, and waste prevention. Before joining the European Commission, he worked for the Permanent Representation of the Netherlands to the EU

D'Hooghe, Johan [The European Demolition Association, Brussels]

Vice President of the EDA International Committee. Expert in construction and demolition waste management (more than 20 years of experience), environmental coordinator, expert in soil remediation, geohydrologist and explosive engineer.

Ehlert, Christina [Luxembourg Institute of Science and Technology, Luxembourg]

Since 2016 at LIST to advise the Luxembourgish Ministry for Sustainable development and Infrastructures on design and implementation of environmental legislation. A focus is on developing and implementing policy measures for selective deconstruction, with particular focus on implementation of material inventories. Raise awareness and support companies in implementation of legislation is part of the job!

Before as Scientific Officer involved in the environmental risk assessment of food and feed products at EU level.

PhD in Plant Ecophysiology and Master in Biotechnology

Galan, Berta [University of Cantabria, Spain]

MPhil. in Material Science from Bath University (U.K.) and Ph.D. in Chemistry from the University of Cantabria and nowadays a Lecturer in Chemical Engineering at the University of Cantabria, UC, Spain. She is involved (1992/Present) in the UC Chemical Engineering Degree and Master/Doctorate Programs "Industrial Engineering". The research activity developed is focused on subjects related to i) Simulation and optimization of chemical and environmental processes and industrial plants ii) Construction and demolitions wastes.

Collaboration in Research and Development Projects at International, European and National level as well as transference results projects with the industrial sector. She has participated in more than 30 SCI papers, 1 invention patent, 40 International Congress and 4 Ph Thesis supervision. During 1998 and 2010 developed research stays of 6-8 months at the Chemical Engineering Department of the Carnegie Mellon University (USA).

Gobbo, Emilei [Université catholique de Louvain, Belgium]

Emilie Gobbo is a research fellow at the Faculty of Architecture, Architectural Engineering and Urban Planning (LOCI) at the Université catholique de Louvain (UCL). She graduated as an architect in 2007. After four years spent in architecture and sustainable development research offices, she joined the university UCLouvain and the research team Architecture and Climat to carry out a PhD thesis. She obtained the title of doctor in art of building and urbanism in 2015. Since then, she has been working as coordinator and researcher for an ERDF funding project that pursues the objectives initially developed in her thesis.

Her areas of expertise include: urban metabolism (bottom-up approach), circular economy applied to the construction sector, analysis of the existing building stock, energy retrofitting strategies and the impact of these on the consumption of resources and the production of waste, waste treatment and valorization opportunities.

Heidrich, Oliver [Newcastle University, United Kingdom]

Since 1992 Oliver has worked with national and international companies, local authorities and Universities in waste, recycling, environmental, life cycle assessment, stakeholder and corporate management. He was a director of Econoplas, a plastic manufacturing business and SEQM a business consultancy business.

He provides detailed understanding of the inter-relationships between resource use and their spatial distribution within and outside cities, in relation to climate change, the built environment, and associated resource requirements. Besides his many expert reports and research papers, Oliver is concerned to see the results of his research disseminated through the wider press and digital media.

Hobbs, Gilli [Building Research Establishment, United Kingdom]

Gilli is a Director at BRE with 25 years' experience in researching and delivering improvements to the built environment, specialising in resource efficiency and more recently circular economy and strategic advisory support. Gilli has been instrumental in moving the 'materials and waste' agenda forward in the construction industry including managing and undertaking high-profile work such as the EU funded Buildings as Material Bank (BAMB) project, development of Resource Efficiency Action Plans, the BE AWARE project and the EC funded project looking at construction and demolition waste practice across the EU member states.

She has been responsible for developing best practice in construction and demolition waste management, such as waste benchmarking and prevention programmes and projects. She has collaborated and worked with a wide range of clients such as the European Commission, UNDP, University of Brasilia, Foreign Commonwealth Office and has representation on a wide range of forums including ISO committees and the CIB (International Council of Buildings).

Koostra, Lucinda [TNO, Netherlands]

Lucinda Kootstra works within the unit Circular Economy and Environment of TNO, the organization for applied research in the Netherlands. Last years she worked on multiple life cycle assessments (LCA) in field of buildings and infrastructure, methodological development of implementing circular economy principles in LCA and development of an urban stock model of the Netherlands. She will present the current progress on predicting the supply and demand of (secondary) building materials and coupling to technology scan to recycle & reuse construction demolition waste.

Kral, Ulrich [Technische Universität Wien, Austria]

Educated in Austria (doctoral degree in technical sciences, Vienna University of Technology), Dr. Kral holds a post-doc position at the Institute for Water Quality, Resources and Waste Management at Vienna University of Technology. His research focuses on the life cycle of materials in the anthroposphere, in particular on methodologies to analyse, evaluate and manage material stocks and flows. His PhD thesis focused on an indicator to assess material flows that leave the anthropogenic material cycle into regional sinks. The indicator provides guidance to manage material flows with respect to available sink capacities and allows benchmarks between different regions. Since PhD graduation, his focus is also on the assessment of anthropogenic material stocks in infrastructure assets. He chairs the COST Action “Mining the European Anthroposphere”.

Osmani, Mohamed [Loughborough University, United Kingdom]

Dr Mohamed is the Director of Sustainable Design and Construction Programme at the School of Civil and Building Engineering, Loughborough University, UK. He is currently leading several international panels and working groups, including BS 8895 series; IWWG C&DW Task Group; and the EU COST Action CA15115 MINEA Working Group on ‘Resource Potential of Construction and Demolition Waste’. He is also a Member of numerous expert groups, including the European Commission International Circular Economy Missions; the United Nations Economic Commission for Europe (UNECE) Expert Group on Anthropogenic Resources; and the UK Government Green Construction Board Resources & Waste Task Group.

Piña Ramírez, Carolina [Universidad Politécnica de Madrid, Spain]

Professor of the Department of Architectural Constructions and Control, PhD in Technological Innovation in Building, Master in Technological Innovation in Building, master’s in Project Management and MBA, Technical Architect from the Polytechnic University of Madrid, also Building Engineer from the Pontifical University from Salamanca where she has also been a lecturer for 10 years. She is freelance and has worked in engineering as a Project Manager. Her research is included in the area of Environment and Sustainable Construction, specifically within Construction and Demolition Waste Management for its use as new materials for construction. During the last years, he has published several scientific papers on this topic, as well as has participated in several international conferences and congresses.

Romnée, Ambroise [The Belgian Building Research Institute, Brussels]

Ambroise Romnée is a civil engineer. He has been working in the sustainable development laboratory of BBRI for 3 years on topics related to the circular economy in construction. He is involved in many European or regional research projects aimed essentially at the development of the circular economy in construction. He is the author of numerous publications including the BBRI's monograph on the circular economy.

Tekin, Hamdi [Istanbul Arel University, Turkey]

I have been working as a lecturer and researcher at civil engineering department at Istanbul Arel University since 2013. I finished my PhD study in Civil Engineering at Yildiz Technical University in Istanbul in December 2017, after getting my master degree in Computational Engineering at Ruhr University-Bochum in Germany. In addition to my bachelor study in Civil Engineering at Middle East Technical University in Ankara, I finished associate degree in Business Administration at Anatolian University in Turkey. My main research fields are construction management, sustainability, environment and energy.

Vanden Eynde, Annelies [Tracimat, Brussels]

Annelies Vanden Eynde graduated in 2007 as an environmental engineer at the university of Louvain (Belgium), and has since gained over 10 years of experience within soil & groundwater investigation and remediation, and waste management. Since 2015 she has been working for the Flemish Construction Confederation and in those past 4 years Annelies has primarily focused on construction and demolition waste. She has been working fulltime on the quality management system Tracimat to enhance waste identification and waste traceability.

Annelies has also been closely involved in the European project HISER (in which tracimat has been partially developed), and has participated in several other European projects on construction and demolition waste management

Vegas, Iñigo [Tecnalia, Spain]

Dr. Iñigo Vegas is senior researcher, PhD in materials engineering and Industrial Mechanical Engineer by the University of Basque Country (Spain). Degree in Business Innovation and Business Management by the Deusto Business School (Spain). He has been working at TECNALIA since 2002, providing 15 years of experience on project management, solid waste recycling technologies and building materials research and consultancy.

He has been scientific coordinator of three EU funded FP7 and Horizon 2020 projects: IRCOW; HISER and the VEEP project. He is author of 31 SCI scientific papers dealing with waste management technologies and eco-innovative cement based materials (H factor =11). Member of the Spanish Committee "C2-Sustainable Materials" within the Scientific-Technical Association for the Structural Concrete.

Ventura, Anne [IFSTTAR, France]

Dr Anne Ventura is research director at IFSTTAR. She's conducting researches in methodological developments for eco-design based on Life Cycle Assessment since 2002. She's been the leader of chair of civil engineering eco-construction for four years at University of Nantes. Today she leads the CoDiUM (Combining Disciplines for Urban Metabolism) research group in the IRSTV research federation (Institute of Research in Sciences and Technologies of Cities). The CoDiUM cluster aims at contributing to better understand and model mechanisms below flows circulating in cities and regions, and providing economic, environmental and social assessments of considered activities, and bring out actions levers for various actors inside the system, to reach more sustainable systems.

Villoria Sáez, Paola [Universidad Politécnica de Madrid, Spain]

She is a Building Engineer with a PhD from the Technical University of Madrid (UPM). She is an assistant professor at the School of Building Construction and is a member of the [Building Technology and Environment Research Group \(TEMA\)](#). She teaches several construction and CDW management related subjects at UPM. Her background and experience is a combination of research in the area of waste management, sustainable materials and built environment. Presently she takes part as a core member of two EU COST Actions: MINEA (CA15115) WG1 on "Resource Potential of C&D Waste" and RESTORE (CA16114) WG3 "Restorative building and operations". Over the past years, she has participated in 12 projects; published over 20 articles in high-impact journals and more than 60 technical reports and paper conferences.

Vrijders, Jeroen [Belgian Building Research Institute, Belgium]

Jeroen Vrijders (36) is the head of the laboratory for Sustainable Development of the Belgian Building Research Institute. He is a Civil Engineer in Construction & Environmental management (2005) and has a broad expertise in recycling of C&DWaste, circular economy in the construction sector. He's active in several national & international organisations related to sustainable construction & recycling.

Weimann, Karin [BAM Federal Institute for Materials Research and Testing, Germany]

Personal Profile:

- researcher in the field of building material recycling
- main topics: (wet) treatment of building material waste, concrete fines, gypsum, environmental evaluation
- committee work

Experience:

- different research projects on building material recycling
- 10 years construction manager (remediation of contaminated sites and groundwater remediation, foundation engineering)

Education:

- Master of Engineering (Dipl.-Ing) environmental technology, main focus on waste management
- Doctorate in Civil Engineering (doctoral thesis about wet treatment of crushed concrete fines)

Abstracts

(in chronological workshop program order)

The revised Waste Framework Directive: implications for C&DW and future policy trends

Chiel Berends (The European Commission, Directorate-General for Environment)

In 2018, the EU's waste legislation was revised, making the European Union the global front-runner in waste management and recycling. The new rules - based on Commission's proposals part of the Circular Economy package presented in December 2015 - will help to prevent waste and, where this is not possible, significantly step up recycling of municipal and packaging waste.

The new legislation strengthens the "waste hierarchy", i.e. it requires Member States to take specific measures to prioritize prevention, re-use and recycling above landfilling and incineration.

Despite its potential for recycling and re-use, the level of recycling and material recovery of construction and demolition waste varies greatly across the Union. Directive 2008/98/EC on waste includes provision to prevent waste generation and to encourage the re-use of products and the setting up of systems promoting repair and re-use activities, including for construction materials and products.

Recovery potential of demolition waste: The sky is the limit!

Johan D'Hooghe (The European Demolition Association)

Construction and civil engineering provided us during the last hundred years with a lot of materials becoming available after demolition and renovation. The potential of these materials depend on many factors. Such as:

1. presence of dangerous waste fractions;
2. quality/price of recovered materials vs. new materials;
3. quality/price of recycled materials vs. primary materials;
4. presence of recycling facilities in the particular region;
5. need of materials in the particular region; and last but not least
6. is landfilling of demolition waste still the cheapest and legally accepted solution?

Taking into account all those factors the demolition company can select the best way to provide his service: recycling space. Recovering and recycling of materials is an important component of this service. The recovery potential reaches from the bottom of the building to the top of it. And seen from the sky, the view of urbanized areas can provide us with a lot of numerical information. Therefore “The sky is really the limit!”.

The recovery potential of demolition waste shall consequently be framed by the technology, economy and quality standards applicable on demolition activities. Most probably the actual standards will change in the near future because of the climate challenges!

Buildings as material banks (H2020 project: BAMB)

Gilli Hobbs (Building Research Establishment, UK)

What makes a building a material bank? It is interesting to consider that older buildings are great examples, in their ability to adapt and deconstruct for reuse. Historically, the reuse of building materials and products has been high, with the materials building blocks of old structures typically used to form new ones, and old materials repurposed until no longer fit for use. However, this has given way in the last few decades to recycling and recovery which typically requires breaking down waste into a homogeneous material for a lesser value application or introduction as replacement feedstock for manufactured components. Part of the reason for this is irreversible and inflexible design choices, and partly due to lack of information on products and materials, which make their further reuse challenging due to possible risks in certain applications.

The Building as Material Banks (BAMB) project received EU Horizon 2020 funding to develop new ways of thinking and understanding in terms of retaining the highest utilization value of buildings, systems, products and materials as possible; supporting dynamic & circular design, and systems thinking in making the most of our built environment and its resources. Some of the key findings from the multifaceted work programme will be described, alongside illustrations of the material and carbon savings achievable through the application of Reversible Building Design (RBD). Alongside RBD and use of Material Passports/product data, a set of policy recommendations will also be summarized to facilitate a transformation in how buildings, and their material resources, are designed, built, managed and disposed of.

Innovative approaches to C&DW management in Belgium

Jeroen Vrijders and Ambroise Romnee (The Belgian Building Research Institute)

Many different initiatives are taking place as we speak in Belgium in order to better manage, recycle and reuse construction and demolition waste.

In terms of construction waste, BBRI has guided 17 construction sites in the implementation of innovative approaches (monitoring, specific collection solutions, human resources & symbiosis). This has led to some interesting conclusions and next steps.

For the large waste streams coming out of demolition works, the industry is trying to ‘close the loop’. Recycling concrete aggregate into new concrete becomes a more standard practice, but there remain challenges. Also other types of waste or industrial by-products are seeking their way into the construction sector.

When it comes to recycling the non-stony fractions – gypsum, glass, insulation materials, PVC, wood, ... - practical challenges need practical solutions. The ongoing experiments are sometimes successful, but for most of the waste streams, it’s a struggle to survive. It is interesting to compare the different approaches and define the future steps in this domain.

A specific aspect that is more and more addressed, is the potential to reuse construction products as such, avoiding a recycling or downcycling step. This causes specific technical challenges, which BBRI is addressing within the BBSM project.

Finally, a view is given on how future trends, like digitalisation, change in policy and new business models can change the management of C&D Waste in the future.

Traceability and quality management of C&DW

Annelies Vanden Eynde (Tracimat, Belgium)

A densely populated area such as Flanders, with no space for landfills and hence very high landfill taxes, a region with little quarries for raw material is driven towards recycling and reuse. Flanders is one of the leading regions when it comes to recycling, as it already recycles more than 90% of our construction and demolition waste.

Recycling is one thing, but how do you guarantee the quality of the recycled material? Proper management of construction and demolition waste (CDW) – most importantly correct handling of hazardous waste – is thus of great importance and is required to guarantee a good quality of the recycled product. It is equally important that users of the recycling material have confidence in this quality and to convince the users that the material has an equal quality as primary material. To ensure this confidence, it is crucial to know the origin of the material and give the users along the value chain the assurance that the material originates from a process that was performed to obtain a high purity of the material fraction.

Tracimat certifies the quality of pre-demolition audits as well as the selective demolition process by issuing a "certificate of selective demolition" for demolition waste that has been selectively and safely collected and subsequently gone through a tracing system. This tracing system guarantees the selective collection of the demolition waste material, traces it from its point of origin down to the gate of the processing company, and sets as its main goal assuring the processing company of the environmental quality of the input demolition waste.

The presentation will give an overview of the traceability system and other drivers that explain the high recycling rate in Flanders.

Assessment of construction and demolition waste recycling facilities' performance

Berta Galan (University of Cantabria, Spain)

In order to evaluate the recycling potential of different materials contained in C&DW to be recovered, a conceptual framework is developed in this work through the performance of two recycling facilities with different technological levels and the inclusion of a mass balance approach based on rigid input-output analysis of the entire system.

The recycling facility is intended to be a material processing industry, not a storehouse for the rejected materials from other processes, and therefore a steady flow of input and output material is inherent to its operation. In line with this, it was also analysed whether the target of 70% recycling of C&DW by 2020 can be achieved with the current management practices but taking into consideration changes in the composition of waste. This evaluation is analysed through Multi-criteria Analysis (MCA), as being considered a tool to find the best solutions in this field and allows the inclusion of not only economic and technical aspects in the evaluation, but environmental and social issues as well. In addition, a sensitivity and uncertainty analysis are included in order to evaluate the robustness of the results obtained.

This assessment is developed for a northern Spanish region consider as a case-study. The work contains initially the problem definition including scenarios of input stream, performance of the equipment and a flow diagram of each recycling plant to calculate the mass flow analysis of each one. Later, the alternatives included in this evaluation are defined, the evaluation criteria, and their values for each alternative are defined, obtaining the impact matrix needed prior to apply a MCA method. Finally, relevant results are shown and discussion of them and the robustness analysis are included.

Usage of C&DW for ground improvement: a case study from Turkey

Hamdi Tekin (Istanbul Arel University, Turkey)

Global warming, depletion of natural resources and increasing pollution enforce the authorities to implement new strategies to protect the environment and human life. Therefore, it is crucial to find new sustainable techniques for any industrial application. Undoubtedly, construction sector is one of the most energy-consuming sectors.

Turkey is very active in construction sector and hence using sustainable techniques is very important in construction sector for the future. Since there is a plenty of urban transformation projects in almost every cities in Turkey, the amount of construction demolition wastes is considerably high. Then, it is a genius idea to benefit from these wastes in different applications. Because most of the regions are located near earthquake zones in Turkey, ground improvement is an obligation for many projects.

This study aims to highlight the importance of usage of construction demolition wastes for ground improvement by giving different case studies and literature review. In addition, interviews were held with different experts working on ground improvement with sustainable techniques, such as usage of construction wastes.

In conclusion; even though waste usage in ground applications has been rising considerably, the desired level has not been accomplished. Many laboratory researches have been conducted to improve the positive effects of these wastes for ground strength potential. Although the results are promising, further researches are necessary for getting better benefit.

Key Words: Construction demolition wastes, Ground improvement, Sustainability, Environment

Cement mortars reinforced with mineral fibers from C&DW

Carolina Pina Ramírez (Universidad Politécnica de Madrid, Spain)

Currently the construction of buildings is one of the main pollution-generating activities in the European Union, so it is essential that the sector orients itself and evolves towards a circular economy model based on reuse, repair and recycling construction and demolition waste (CDW).

The use of insulating materials is currently booming due to the increase of thermal and acoustic requirements marked by regulations about the construction of homes, which seek to contribute to energy savings and improve thermal comfort. This increase in the use of insulating materials has caused an alarming growth of mineral wool waste -as it is the most used insulation in the European Union-, so it is essential to recycle or reuse it, something that is not happening today, incorporating those materials to the circular economy criteria.

It's of great importance to study the feasibility to use fibers from recycling for the mortar's reinforcement and, in this way, to be an ecological alternative to the reinforcement fibers used today.

In addition, this waste will replace part of the aggregate of the mortar, a fundamental issue if we take into account that the extraction of sand worldwide has skyrocketed in the last 30 years, being the most demanded natural resource in the world after water.

The properties of these reinforced cement mortars are determined through testing, both in the fresh state and in the hardened state, checking their suitability to the prescriptions of the current regulations and thus being able to be used in the field of sustainable construction.

The results show that even though the mechanical resistance decreases there is a good connection between the cementitious matrix and the residues, while also maintaining optimal durability properties, making it a sustainable and innovative alternative to the commercial fibers currently used by the company reinforcement of mortars.

Gypsum plasterboard recycling

Karin Weimann (BAM Federal Institute for Materials Research and Testing, Germany)

The use of secondary building materials can meet the requirements of sustainability in several ways: the extended time availability of primary raw materials and, thereby, the protection of natural resources as well as the conservation of landfill sites. Regarding the predicted decrease of gypsum supply in Germany, particularly the recycling of gypsum (calcium sulfate) is of growing importance. Currently, the gypsum demand is fulfilled (at least 60%) by gypsum as side product from coal-fired power plants (FGD Gypsum). Germany's natural gypsum deposits fulfil the remaining gypsum demand. Due to national climate protection goals the gypsum supply from coal power plants will decrease significantly in the future.

In addition, the content of sulfates in other secondary building materials, in particular in recycled concrete aggregates, should be minimized for quality reasons. Separated gypsum can be used in gypsum production if the high quality requirements for recycled gypsum are met. Accordingly, there have been significant advancements in the processing of gypsum residues in the last years. Since almost all processing steps in the recycling process are associated with environmental impacts, an environmental evaluation of the use of recycled gypsum as a substitute in gypsum production has to be carefully conducted.

The presentation focusses on the techniques for generating recycled gypsum from gypsum plaster boards, the related quality requirements and a comprehensive environmental evaluation of the complete process.

Energy retrofit and material

Emilei Gobbo (Université catholique de Louvain, Belgium)

With the spreading of population and urbanization, the dependence of European cities on external services and supplies continues to increase. At the same time, an ageing building stock imposes significant pressure on energy demands. This situation has led Europe to adopt directives on the energy performance of buildings. Energy retrofit has become necessary to address ongoing environmental concerns, although these also increase the production of waste and the pressure on the extraction of natural resources.

To address these challenges, new approaches are arising and, among them, circular economy is now a broadly used concept. However, circular principles are not necessarily consistent with energy concerns. Combining those two approaches represents an important challenge for the construction sector, nowadays as in the future. Gathering information on the source and quantities of material flows is required to apply circularity in buildings' construction and renovation.

Current urban metabolism studies are usually based on top-down approaches, but there is still a lack of data regarding the building stock and the material flows generated by retrofit processes is often not questioned. This study is part of the European Regional Development (ERDF) funded project BBSM (Brussels' Building stock as Source of new Materials). BBSM aims to consider the current need of retrofit strategies in an urban mining and circular perspective: cities are full of potentially valuable materials that are already on-site and can be reused or recycled for local needs, saving natural resources and lowering environmental impacts.

This paper presents the methodology followed to develop a tool that performs material balances to assess the impact of various energy retrofit scenarios on material stocks and flows. These material balances - based on a bottom-up approach - are calculated in three distinct phases: material stock before any energy retrofit; material in- and outflows; and, new stock after retrofitting.

Connecting the supply and demand of secondary building materials: estimating the environmental impact of reprocessing technologies for façades and roofs

Lucinda Kootstra (TNO, Netherlands)

Recent years, the awareness of climate change and circular economy grew exponentially in the Netherlands. There are three parallel developments that explain the growing interest in reuse and recycling of construction demolition waste (CDW):

1. After the financial crisis, there is catch-up construction of dwellings mainly by densification and redevelopment of inner-city industrial areas. This leads to a huge demand of building materials (and corresponding environmental impact) and more CDW.
2. It is expected that road construction will decrease and thus the demand for backfilling, currently the main use of CDW, is decreasing and new ways to recycle, but maybe also reduce, reuse, refurbish CDW are needed to prevent huge waste management problems.
3. The Dutch government agreed to reduce the CO₂ emissions of the build environment with 3.4 Mtons in 2030 and has the ambition to be fully circular in 2050. As a result, there is attention for the embedded CO₂ emissions of construction of new dwellings and ambition to drastically renovate current building stock.

To get insight in the amount of CDW and demand for new construction materials TNO developed an urban stock model for the Netherlands last years. It gives insight in the amount and composition of CDW and demand of construction materials until 2050. Based on this information, currently is researched which reprocessing technologies can use CDW as building block for new building materials. The goal is to compare reprocessing technologies that will be on the market coming 5 years that reduce, reuse, refurbish or recycle CDW, and possibly also reduce the environmental impact of construction of new buildings.

Up to now, an overview of these reprocessing technologies for several types of facades and roofs were created, showing the different options, but also the environmental impact of these reprocessing technologies when they would be applied during renovation of current building stock.

Environmental assessment of Cement Concrete Demolition Waste recycling at regional scale combining LCA, MFA and a local economic market model

Anne Ventura (IFSTTAR, France)

Recycling of Construction and Demolition Waste (C&DW) is often regarded as a solution to avoid environmental impacts of producing construction materials issued from virgin resources. Our work focus on recycling of Cement Concrete Demolition Waste (CCDW).

Previous LCA studies did not model the quarry process as a multi-output process producing different qualities of natural aggregates. However, the displacement of the quarry process as a whole by the recycling process is arguable, since Recycled Cement Concrete (RCC) only replace basic quality natural aggregates (A1) that are dependent co-products of the quarry process. The quarry production is driven by the demand for high quality natural aggregates (A3).

Furthermore, the amount of available A1 is confronted to the market demand for basic quality aggregates (BQA) and compete with RCC. The environmental benefits of the displacement of A1 production thus depend on the actual amount of produced A1 (and thus the market demand for A3), the actual volume of produced RCC and the actual market demand for BQA.

In addition, because construction aggregates are ponderous materials, their total costs for their customers are very sensitive to transport costs, and thus economic markets are local. However, very few LCA studies considered a regional approach with local production processes. Most studies assumed average transportation distances and their results are found sensitive to those distances.

Our objective is to develop a method aiming at calculating the environmental impacts of the CCDW management system at regional scale. We develop a new conceptual model based on Material Flow Analysis at regional scale, including market share of BQA between RCC and A1, and preserving physical relationships between the quarry co-products A1, A2 and A3. We apply this method to a case study: the Loire-Atlantique (LA) region in France.

Managing construction resources in Europe and emerging economies: raw materials and disposal of cement and concrete in the UK and Thailand

Oliver Heidrich (Newcastle University, United Kingdom)

Increasing housing and infrastructure demands as part of population growth and urbanisation across the world, and in Thailand (and elsewhere in Southeast Asia) in particular, lead to increased mining and use of non-renewable mineral raw materials that are needed for the construction industry. To evaluate the material flows associated with construction and demolition in different countries it is necessary to have a consistent set of data. However, data collected by regulators and governments differ and this study (Tanginthai et al., 2019) uses concrete as a case in point to provide policy and management guidance.

Current waste management policies are insufficiently mature to reduce wastes that could replace inputs to construction through reuse or recycling alone. Through regulation developed as part of the European Union (EU), Great Britain has implemented integrated policies and achieved high rates of recycled aggregates in construction (29%) and a 70% reuse and recycling target for construction and demolition (C&D) waste.

Flows of natural components, cement and aggregates, are investigated from extraction to final disposal following demolition. A comparative Material Flow Analysis (MFA) for the construction industry in Great Britain and Thailand has been used to quantify raw material inputs and building and infrastructure outputs, so that practice can be compared for a European and a developing country.

We report domestic cement production and import/export data, and calculate the raw materials needed for cement and its calcination process for concrete production. Considering the most relevant policies and taxation in Great Britain, we identify possible ways forward for Thailand by introducing new policies and taxation that will have positive effects on raw material extraction, processing, construction and disposal practices and disposal behaviours. Following the MFA and policy analysis reported here, we believe that similar benefits can apply to other emerging economies if lessons learned are taken on board.