Renotech Oy

Use of Slags and other Waste derived materials in Construction

Valter Wigren
1.12.2022

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- Concrete – Most used man made material
- History and use of Alkali activated systems
- Slag based technologies
- Bottlenecks of increased waste use

Renotech

- Renotech established in 1994
- Finnish SME with global ambitions
- Member of Smart Chemistry Park
- Bob Talling MD and owner
- Total staff of 15
- Good balance between genders and foreign experts
- 2021 turnover less than 2 million

Business Units

Marine Solutions: MED certified items

Fireproofing: For buildings

Acoustics: For ships and floors (non MED)

Construction: Corrosion proof basalt fibres, Non combustible glues

R&D Consulting: Circular economy, Ash2Cash, Wastewater treatment

Highlights

EU RESLAG project where steel slag is converted to Refractory materials. Got featured in EU media. 2019

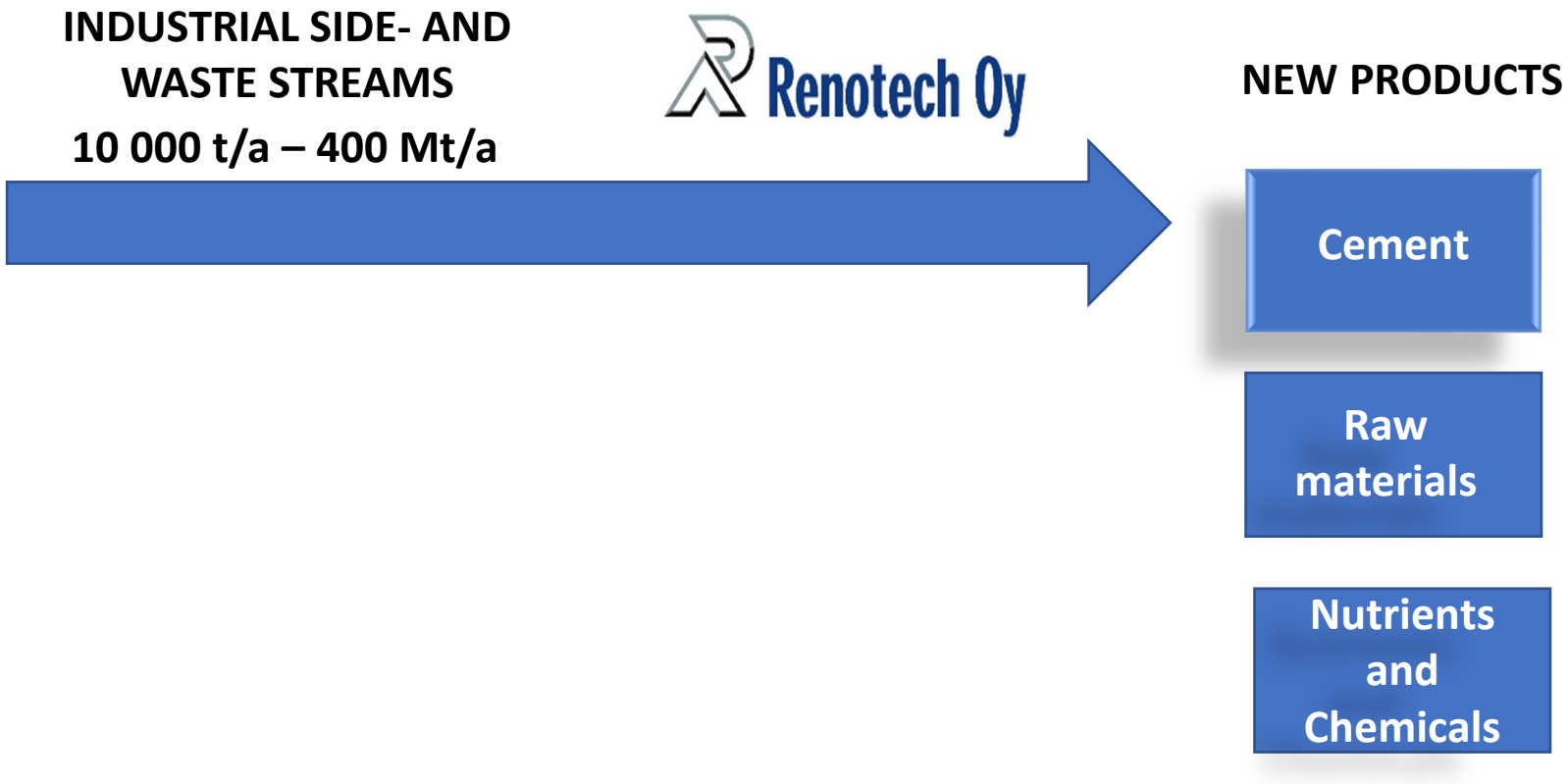
Conversion of ashes, slags etc green cement product Ash2Cash finds application with Ekokem, Fortum, Ecolan etc. 2018

We have contributed to every cruise ship project in Finland. 1994-2019

Conversion of moon dust (yes from moon) to high strength bricks with US Army. 2000

We are key partner of Finnish giants such as Fortum, UPM, Paroc, Finnsementti, Berner Oy etc for circular economy related solutions.

ReUse of High volume industry sidestreams



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Team

Valter Wigren

R&D Director

- Expert in circular economy & sustainability project management
- +10Y exp. as R&D engineer &manager in University of Turku, Ekolite Oy
- M.Sc. Chemistry

Bob Talling

CEO

- +40Y exp. in chemical engineering, construction materials, insulation & marine businesses
- +25Y exp. as CEO of Renotech.
- M.Sc. Chemical Engineering

Johnny Liewendahl

Product Quality Chief

- 20Y exp. in concrete and dry mix products as R&D manager
- Quality chief in important companies from Finland like Nordkalk & Lahti Precision

Jouni Karhu

Project Engineer

- +20Y exp. in industrial R&D at Outotec Research
- University research in the Process Chemistry Group at Åbo Akademi.
- M.Sc. Chemical Engineering

Mia Berg

Laboratory Engineer

- +10Y exp. in Dental Tech-teaching & Dental Laboratories
- B.Sc. Materials Technology

Partners

SAINT-GOBAIN

BERNER CHEMICALS

SAKRET

KiiLTO

fortum

FESCON

POLITÉCNICA

Metsä

outokumpu

Advisors

Dr. Bjarne Holmbom
Professor emeritus & chairman of Separation Research company

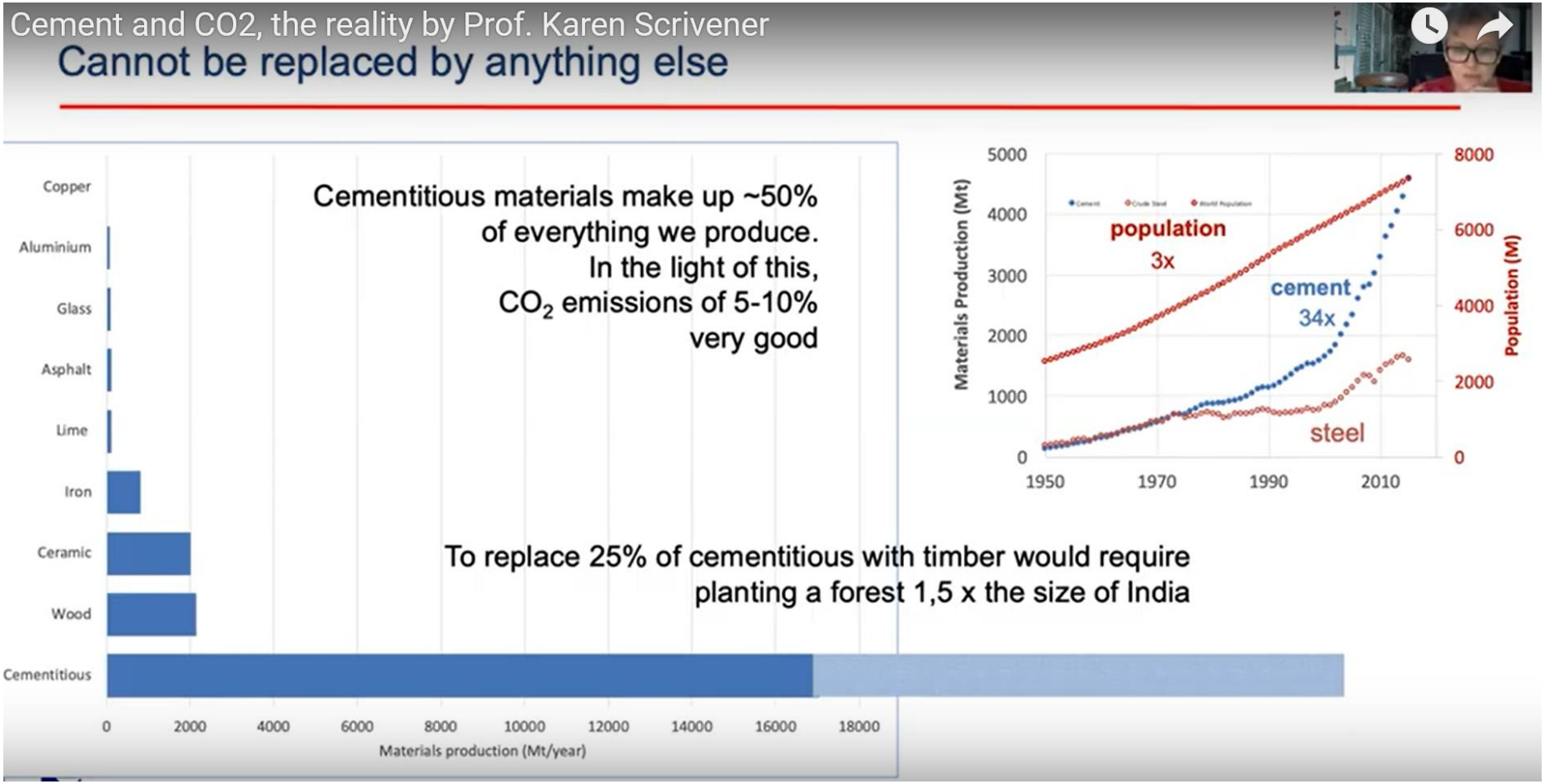
M.Sc. Erik Nordenswan
Chemical engineer & Senior Researcher, Nordkalk (ret), Scientific Advisor

M.Sc. Rainer Ålgars
Research Manager, Weber st. Gobain (ret), Scientific Advisor

- 15 Mrd m3 betonia

- **n. 5 Mrd tonnia Sementtiä**
- **30 Mrd tonnia kiviainesta**
- 2,5 MRd tonnia vettä

Betonin ja sementin käyttömäärät

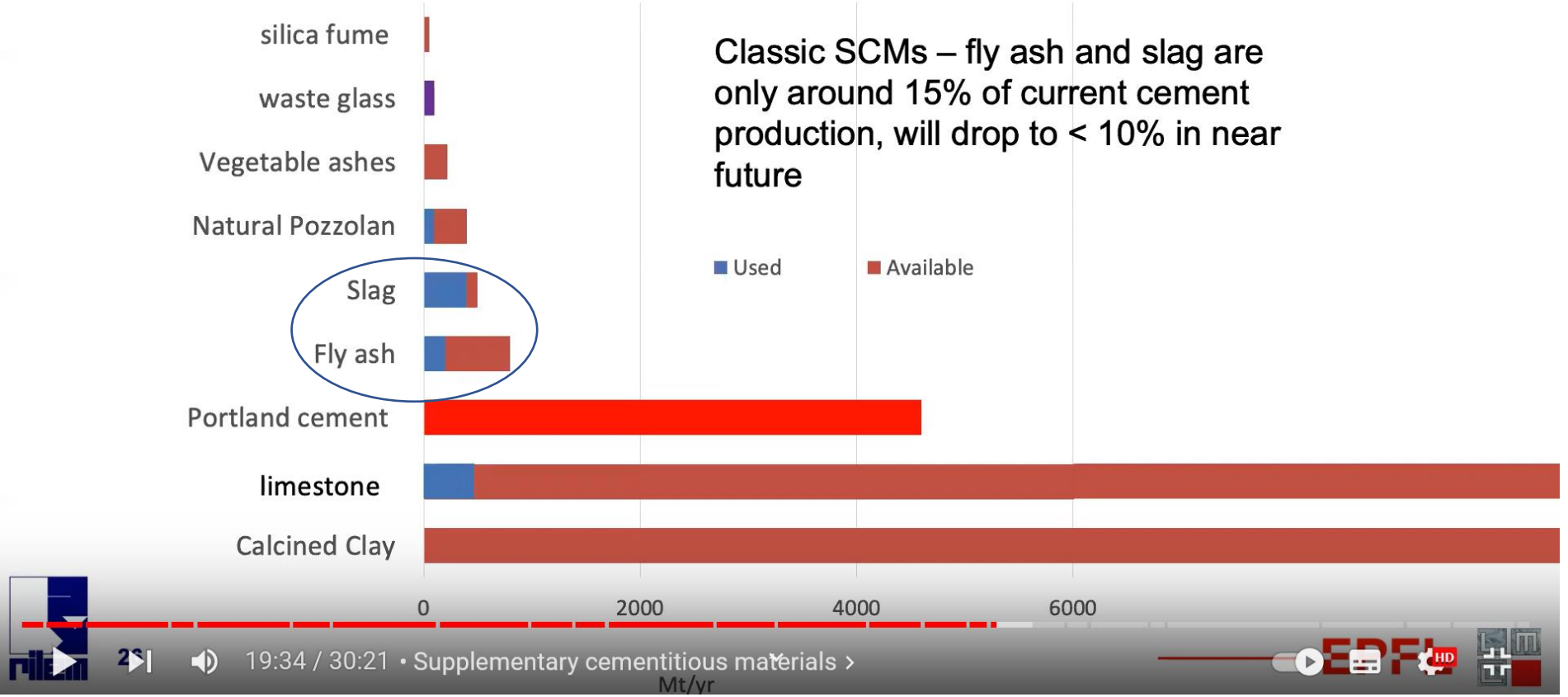


- Käyttö kasvaa -> Materiaaleja käytetään vielä enemmän kuin tällä hetkellä

https://www.youtube.com/watch?v=a7fpWA19aYc

Cement and CO2, the reality by Prof. Karen Scrivener

Availability of SCMs



Bob Talling – A history of circular technologies

- 1980-82 F-CEMENT STUDY RECOGNIZING PROBLEMS WITH SHRINKAGE, CRACKING,CARBONATION
- 1982 CONTACTED GLUKHOVSKI IN KIEV
- 1983-94 PARTEK CEMENT PRODUCTION AND APPLICATIONS. NEW RAW MATERIALS, SUBSTITUTED CEMENTS, HIGH EARLY STRENGT CLINKER,
- NEW ALTERNATIVE BINDERS BASED ON MAINLY ALKALI ACTIVATED SLAG. TYPE APPROVED AFTER EXTENSIVE FACTORY PRODUCED PRODUCT TESTING
- 1994 RENOTECH FIRESAFE PRODUCTS
- CONTAMINATED SOILS, ASH IN STABILIZATION
- LONG TERM STUDY; AAM, GEOPOLYMERS, ACTIVATED ASH
- OIL DRILLING CEMENTS WITH SHELL
- MOON CEMENT STUDIES WITH NASA

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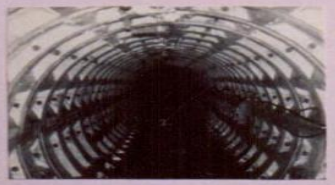
Alkali activated structural concrete in Odessa/Kyiv 1960 ->

Tatarbunar irrigative system
Gutters with prestressed reinforcement, slabs of canal lining are used from 1962-1964.
The strength of concrete for 25 years has increased from 25 up to 70 MPa.
The corrosion of reinforcement is absent. Frost resistance is 900 cycles, watertightness is W 20.



Odessa
Sidewalks
Service from 1964
After 25 years the strength of concrete is 70 MPa.
The surface is smooth.




Odessa
Tubings of drainage adit of anti-landslip construction from concrete of strength 30 MPa.
After 25 years the corrosion of reinforcement is absent, the strength of concrete is 60 MPa.

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AAM Rooftile 1988 ->

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Characterization of an aged alkali-activated slag roof tile after 30 years of exposure to Northern Scandinavian weather

Tero Luukkonen, †[a] Juho Yliniemi, †*[a] Brant Walkley, [b] Daniel Geddes,[c] Ben Griffith,[d] John V. Hanna, [d] John L. Provis, [c] Paivo Kinnunen [a] and Mirja Illikainen[a]

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BLAST FURNACE SLAG - THE ULTIMATE BINDER

Bob Talling and Pavel Krivenko


AAM MSWI Slag walls 2021

MSWI aggregates
Alkali activated binders
Magnesium and magnesium silicate binders
100 % Waste structures

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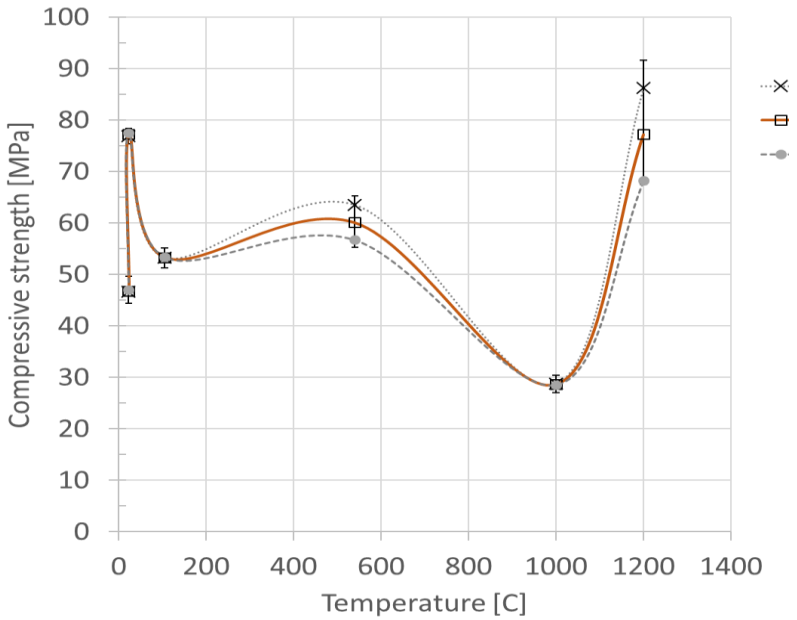
Development of non ferrousSlag based Refractories

REslag

Turning waste into value

- EU fund project for utilizing steel industry slags in Refractory materials
- Developing hybrid binder systems utlizing biomass ash and slags
- Pilot Scale Experiment ongoing in developing Aerated Concrete based on Biomass ash and Slags



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Supersulphated cement

Figure 1. Palais de Chaillot (Paris, 1937), made of concrete with supersulfated cement.

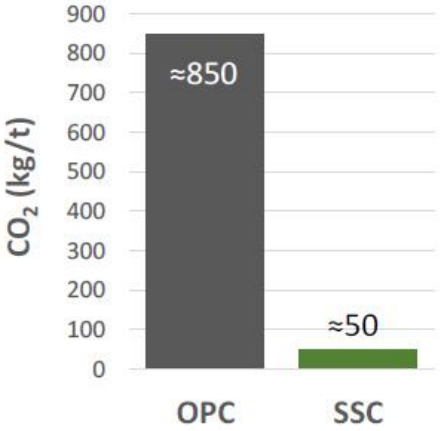

Figure 2. CO_2 production of Portland cement and supersulfated cements, in kg per ton of binder (data from Ecocem).

Table 1. Composition of supersulfated cements, as defined by European standard EN 15743

GGBS	Calcium sulfate	Portland clinker
> 75%	5 to 20%	< 5%

GGBS/Gypsum/Clinker can be substituted with waste based SCMs when available

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Other slag based technologies

Name	Name
Quick hardening alkaline cements for winter concrete works	Polymer silicate paints
High strenght concrete based on slag alkaline binders	Non ferrus slag alkaline binders
Fire resistant concrete based on slag alkaline binders	Steel making slag alkaline binder
Oil-well cements based on slag slakaline binders	Injection mortars based on alkaline cements
Lightweight (foamed) concrete based on slag alkaline binders	Fire resistant mineral coatings
Wood-aggregate slag alkaline boards	Mineral binder composition for timber aggregate boards

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Some Bottlenecks for increased use of Waste

Issue	Details	Suggestion
Lack of standardization	No standardization No CE marking No markets	Push for performance based standardization in applicable products
Value for saved natural resources	Conservation of natural resouces is not shown in value of product	
Raw Material quality	For materials other than GGBS, quality control of available raw materials is lacking	Waste - > Byproduct or product invesments
Raw material availability	Limited producton of material	

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Thank you for listening

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