

Zero Waste materials Project Introduction

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Section for Building Physics and Services

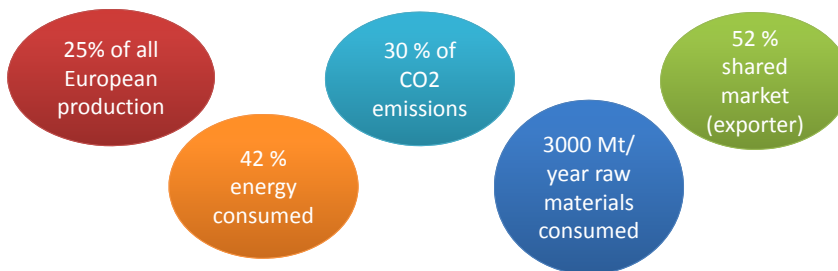
International Center for Indoor Environment and
Energy (ICIEE)

$$\frac{\partial T}{\partial t} = -\frac{\lambda}{\rho c_p} \frac{\partial^2 T}{\partial x^2} \quad \Delta \int_a^b \epsilon \Theta^{\sqrt{17}} + \Omega \int \delta e^{i\pi} = \{2.7182818284\} \quad \infty \quad \chi^2 \quad \Sigma! \quad \gg$$

DTU Civil Engineering
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Why Utilizing Waste?

Construction industry in no.s



+Environmental issue → extraction of raw materials

Redesigned construction materials

How to Utilize Waste?



- Industrial by-products
 - Avoid of landfill disposal and deposit
- **Non-conventional building materials**
 - Mortar, Concrete
 - Concrete ad-mixed products
 - Bricks, Tiles
- Ash in a place of cement/clay
- **Innovative** characteristics



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Recirkulering af byggematerialer 03/09/2013

Objectives



Advanced methodology for material testing

- Material Characterization
 - Hygrothermal
 - Mechanical
- Environmental effect
 - Emissions
 - Mould growth
 - Leaching
- Sorption & Sink Effect
 - VOC
 - O₃
- Visual Effect
 - Patterns
 - Colour

Concept of product development and design as optimal solution for future types of sustainable building constructions



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Raw material replacement

Previous studies



- Mostly focused on
 - Workability
 - Flexural, Compressive Strength
 - Feasability
 - (Water absorption)
- Chemical and mineralogical compositions vary between the different SSA → Variable material properties

Effect of fineness of fly ash on properties of fired bricks (fired at 1050 °C for 8 h according to heating rate in Fig. 2) *

Fly ash:clay (by volume)	Fly ash	Apparent porosity (%)	Water absorption (%)	Bulk density (g/cm ³)	Compressive strength (MPa)
60:40	Original	36.65	23.62	1.55	39.6
	Pulverized	33.88	19.53	1.74	85.9
70:30	Original	39.76	27.54	1.44	27.8
	Pulverized	38.68	24.47	1.58	51.8
80:20	Original	39.80	27.86	1.43	25.4
	Pulverized	38.14	27.24	1.51	37.1

* X. Lingling, G. Wei, W. Tao, and Y. Nanru, "Study on fired bricks with replacing clay by fly ash in high volume ratio," Constr. Build. Mater., vol. 19, no. 3, pp. 243–247, Apr. 2005

Facilities at DTU BYG



Dry/Wet cup method



Climate chambers/Dessicators



Scanning Electron microscope



Guarded hot plate apparatus

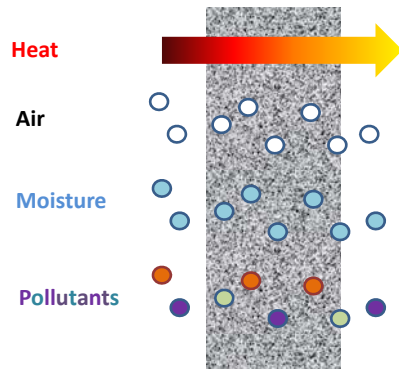


Pressure plate apparatus



Summary

Combined heat, air, moisture and pollution transport



- Effect on:
 - Material characteristics
 - Indoor Environment quality
 - Occupants' health
 - Material life-cycle
 - Durability etc.

THANK YOU FOR YOUR ATTENTION



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