URGENT : LOWER THE ECOLOGICAL IMPACT

“green construction” with Cement ?

Kurt Rhyner, Architect, PhD, Professor

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH

La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

UNhabitat : CONCRETE CAN BE GREEN MATERIAL

innovations in concrete

the alternatives

Research into more sustainable concrete manufacture and construction is essential as worldwide demand for and usage of concrete increases. Alternative methods of reinforcing concrete can enhance its performance in a variety of areas. Of particular interest is Ferro cement construction, which involves reinforcing concrete with wire-mesh and narrow rebar, and can be used to make wall panels, ceiling and floor slabs and roofs. The advantages of Ferro cement construction are that it is possible to build thinner walls and slabs, which are lighter and can be assembled by just a few of workers. Ferro-cement components can be manufactured in informal settings at low cost and may be a good option for relief housing due to its flexural strength and lighter weight.

Apartment house under construction using ferro cement in Dominican Republic © EcoSur

Concrete recycling is another way of reducing the environmental impacts of the material. Recycling concrete takes the aggregate left when buildings and other concrete structures such as roadways, highways and sidewalks are demolished, and uses it to replace natural aggregates like stone, sand and gravel. The advantages of using recycled concrete aggregate are that it is lighter weight and produces a higher yield per unit weight, reduces landfill waste, and often outperforms natural aggregates in concrete products.

Green Materials Technical Notes Series

UN-Habitat promotes the use of green building materials within the context of slum upgrading, large scale affordable housing, social housing, and reconstruction in developing and transitional countries. UN-Habitat supports the adoption of green materials in mainstream building based on affordability and capacity to uphold the 4 dimensions of sustainability. UN-Habitat also encourages governmental support for alternative building materials, which may include adaptations to building codes and providing subsidies.

contact

United Nations Human Settlements Programme
P.O. Box 30030, Nairobi 00100, Kenya
Tel: +254-20-7623120
Fax: +254-20-76234266/7
infohabitat@unhabitat.org
www.unhabitat.org

Global Network for Sustainable Housing
www.gnsh.com
Become a member at member@gnsh.com

resources

Information adapted from "Going Green: A Handbook of Sustainable Housing Practices in Developing Countries".

EcoSur
www.english.ecosur.org

Construction Materials Recycling Organization
Concrete Recycling - www.concreterecycling.org

Concrete Mix Ratio Sources:
"Sugar Cane Ash" - Niels Bohr Institute (www.nbi.ku.dk)
"Concrete without sand!" - http://www.downtoearth.org
"ACI Method Concrete Mix Design" - http://www.aboutcivil.org

Cover Photo © UN-Habitat

GREEN MATERIALS CONCRETE

Concrete is most used man-made material in the world with twice as much concrete used in construction than wood, steel, plastic and aluminum combined. Although concrete has acquired a negative image due to environmental impacts that occur at various stages of its production, sustainable use of concrete is possible by using alternative stablizers and construction techniques and restricting usage to certain building parts. Given that the use of concrete is not likely to decline, it is important that more sustainable techniques of using concrete continue to be researched and promoted.

UN-HABITAT
FOR A BETTER URBAN FUTURE

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

CONCRETE

1 m^3 of concrete

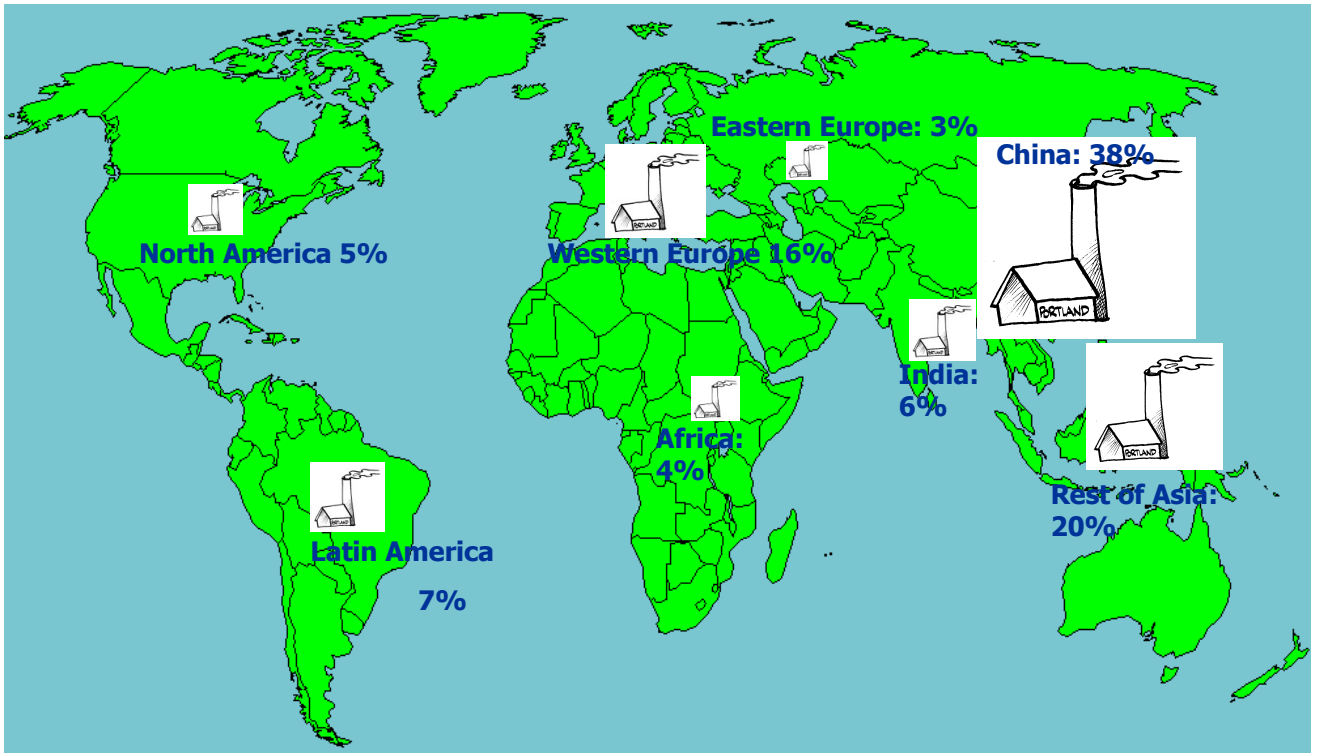
Concrete is the material we use most in construction, approximately 1 cubic metre yearly per habitant of the planet

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH

La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

PORTLAND CEMENT



Production of Portland Cement in 2002 was about **1,750,000,000 tons**. And it grows and grows.....

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH

La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

A DANGEROUS REALITY

Cement production is responsible for almost 6% of worldwide greenhouse gas emission

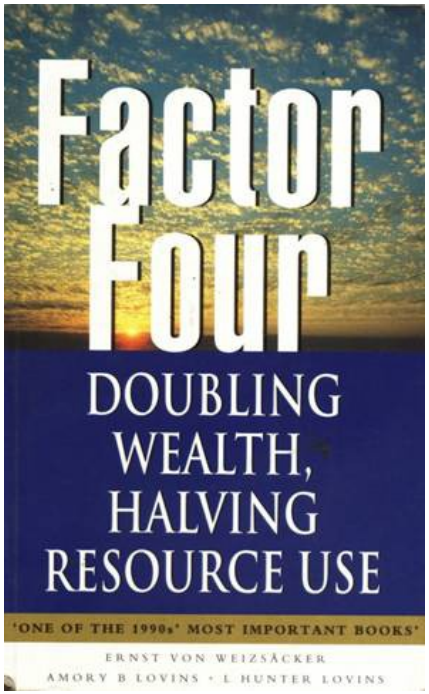
Aggregate mining is another threat to the environment

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH

La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

WE HAVE TO ACT



Radical improvement of efficiency in using concrete (factor four or ten?)…

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

OUR ACTION COULD BE

Optimize cement and aggregate consumption with lightweight solutions

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

FERROCRETE WALLING AND ROOFING SYSTEM

Ferrocrete panels are easy to produce locally, very well suited to emergency actions

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

FERROCRETE WALLING AND ROOFING SYSTEM

Optimize relation of cement / steel / aggregate to produce self supporting Wall and roof elements

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

LOWER THE ECOLOGICAL FOOTPRINT

Embodied energy in walls

Calculation is based on house construction complying with earthquake resistance standards according to Nicaraguan laws and ASTM

walling system	cement	Sand	Steel rods	Soil
	kg	litres	in kg	litres
Hollow blocks 15 cm, with structure of reinforced concrete	47,98	215,63	8,83	0,00
Soil cement blocks with structure of reinforced concrete	52,08	144,51	8,83	224,55
Handmade solid clay bricks with structure of reinforced concrete	40,13	146,34	8,83	195,52
Ferrocement wall panels, including wire mesh	37,46	111,20	7,10	0,00

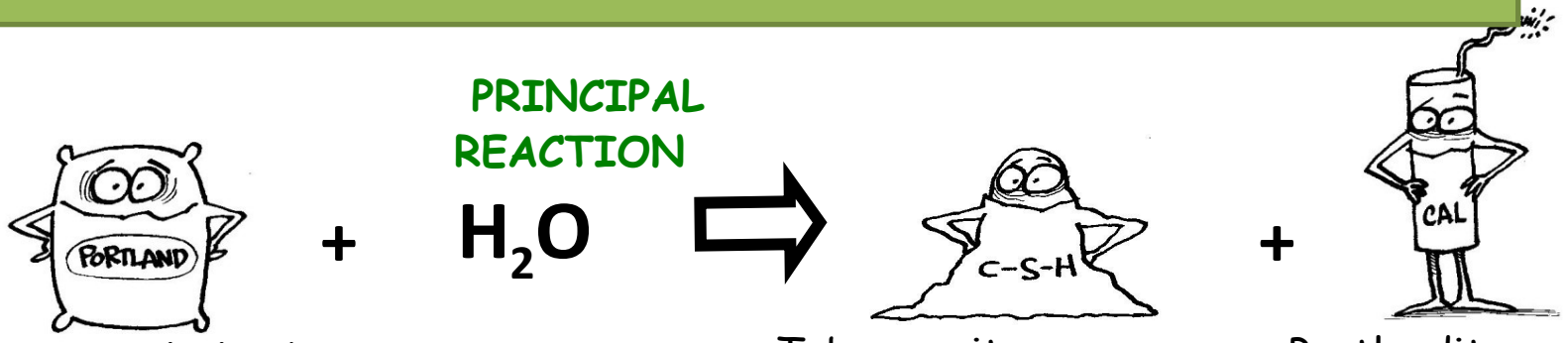
MICROCONCRETE ROOFING TILES

The micro concrete formula
and good workmanship
result in a
low ecological footprint

ECOSUR SOUTH
La Red para el Hábitat Económico y Ecológico
The Network for an Economical and Ecological Habitat
www.ecosur.org

LIME POZZOLANA CEMENT

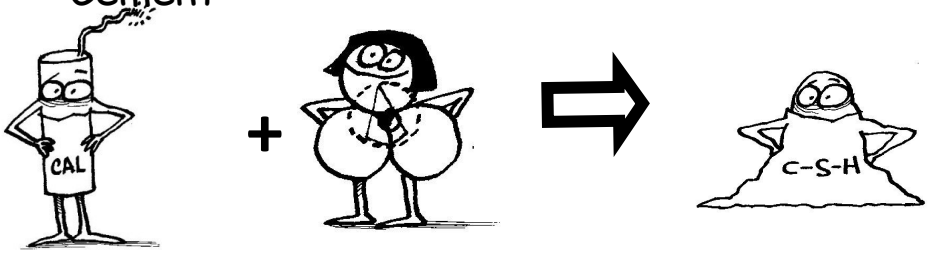
PRINCIPAL REACTION



Pórtland Cement

Tobermorita

Portlandita (lime)



Lime

Puzolana (addition)

Tobermorita

SECUNDARY REACTION

Normal Concrete	15 – 35 MPa	Up to 50% puzolana
Medium resistance concrete	35 –60 MPa	15% - 35% puzolana

This practice is used sometimes since the eighties....

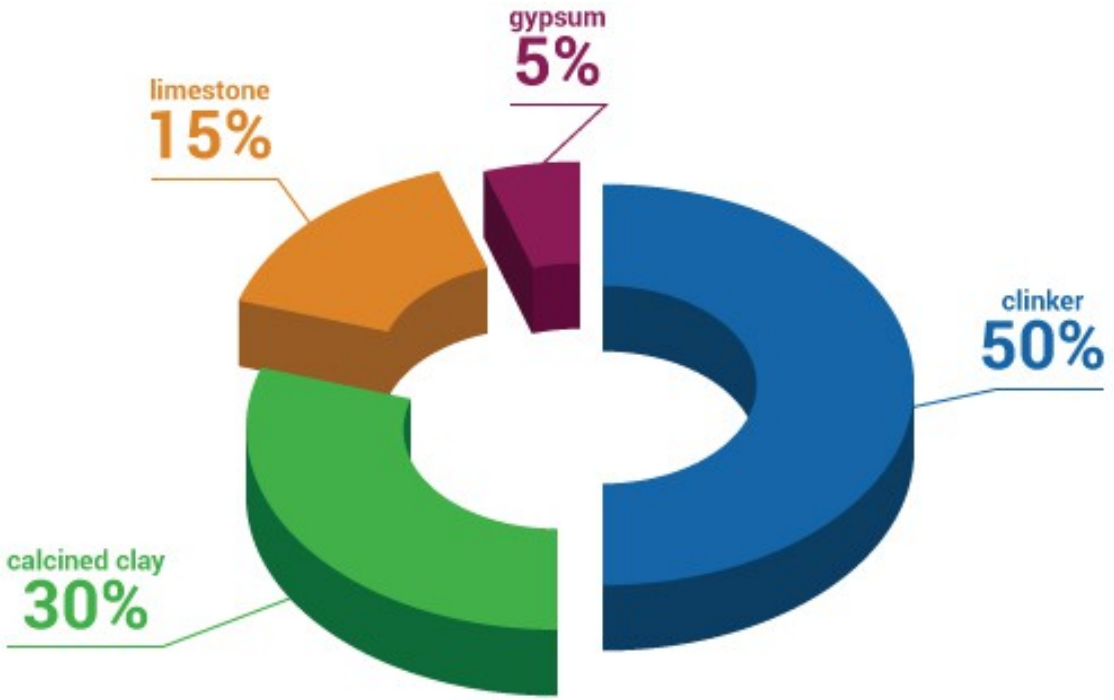
LIME POZZOLANA CEMENT

The EcoSur network has produced some 5,000 tons of lime-pozzolana cement with natural pozzolanas and fly ash.

It was used to produce blocks, foundations and plaster.

However, it was not economically viable.

NEW DEVELOPMENTS

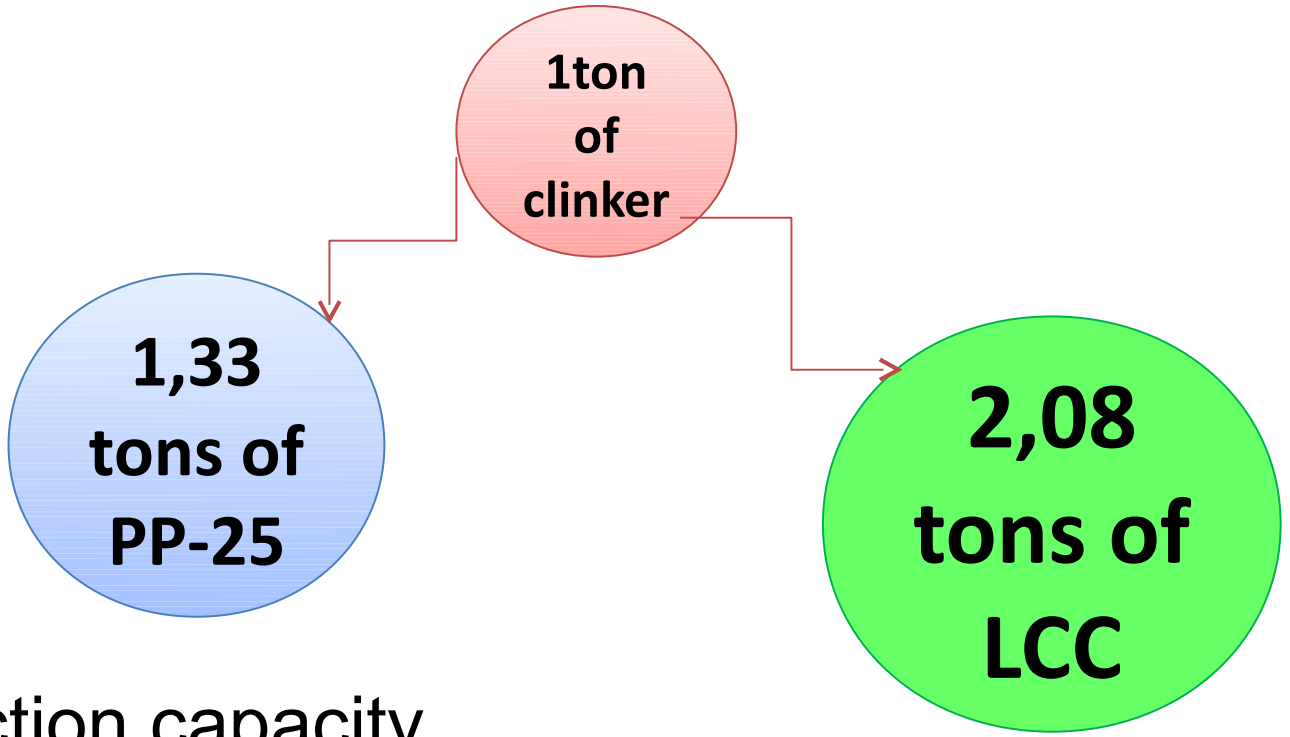


Low Carbon Cement (LCC), an innovative blended Portland cement with addition of metakaolin and limestone.
Reduces the quantity of clinker in cement

Trial productions in Cuba and India are underway.

NEW DEVELOPMENTS

Traditional cement vs composed cement



Production capacity grows by 56% without additional greenhouse gas emission

ACTION

It is our mission to interchange information and knowledge with all interested organizations

We offer support in technologies and specific equipment for "green technologies"

ECOSUR SOUTH

www.ecosur.org

EcoSur is a founding member of the UN-habitat network

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING