

# **Towards More Sustainable Concrete...**

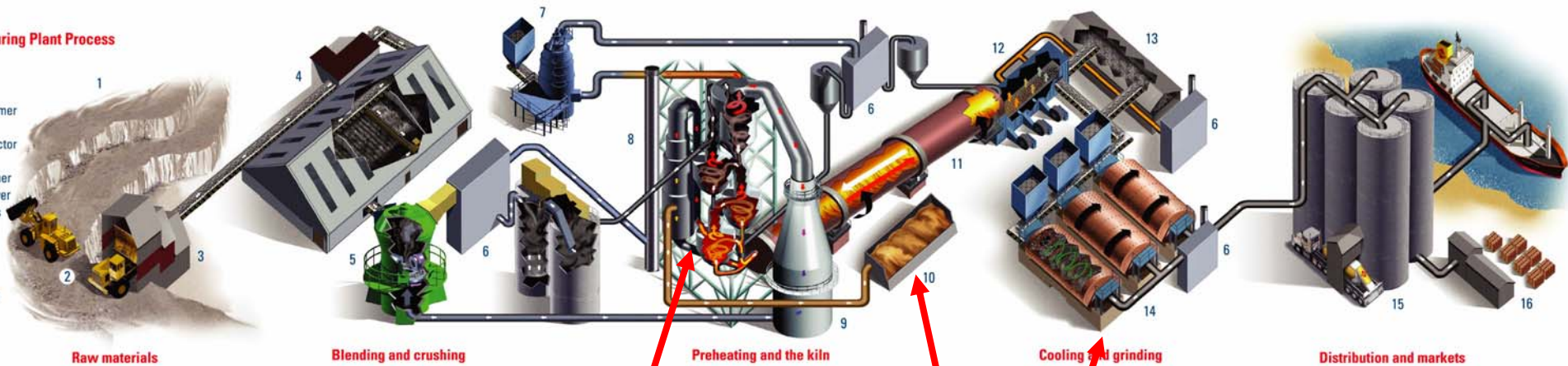
**Leonard McSaveney BE, FIPENZ  
Golden Bay Cement**





**The Portland Cement Works (Whangarei)**

# The Golden Bay Cement Process (2008)



**Pre-calciner**

**Closed Circuit Grinding**

**Raw Materials:**

- Sea shells
- Weathered rock
- Rust

**Bio-fuel storage**

# **Sustainability issues facing the global cement & concrete industries.**

- **Global Warming**
- **Resource Depletion**
- **Waste Disposal**

**Guided by international consensus:**

- **Rio de Janeiro**
- **Kyoto**
- **Copenhagen...**

# **The Global Voice for Structural Concrete:**

**The International Federation for  
Structural Concrete (*fib*).**

**Special Activity Group 8**

**Chair – Prof. Koji Sakai**

**(Kagawa University, Japan)**

# The Role of SAG 8

**Take the lead to advance the sustainability of Structural Concrete.**

**Ensure that *fib* considers sustainability in all of its published guidance documents.**

**Work with *fib* member bodies to keep Building Professionals aware of new developments.**

**Collaborate with other world organizations to advance the sustainability of concrete structures, over their life-cycle.**

**ACI, JCI, RILEM, NZCS, CIA, etc...**



# **Structural Concrete - Regulated by Building Codes & Standards**

**Universal design parameters:**

- 1. Safety**
- 2. Reliability**
- 3. Serviceability**
- 4. Durability**

**Sustainability...**

# **Sustainability Issues Facing NZ Cement & Concrete**

- **Research data has not kept up with process improvements - always ask the supplier.**
- **Lack of NZ skills in rigorous Life Cycle Assessment.**



# **Current Initiatives - with traction:**

- **Green Star**
- **Environmental Choice**

**Not perfect yet, but off to a good start.**

# **Global Concrete Benchmarking**

## **Fletcher Building Ltd**

- The Carbon Disclosure Project**
- GBC measure themselves against similar sized cement plants owned by Lafarge.**

## **Holcim**

- The World Business Council for Sustainable Development**
- Cement Sustainability Initiative (900 plants).**

# Opportunities for Improvements

**The Portland cement manufacturing process:**

- 1. Convert to a dry process rotary kiln.**
- 2. Burn alternative fuels.**
- 3. Add non-kiln derived minerals.**
- 4. Change clinker chemistry & grinding aids.**
- 5. Improve storage and distribution methods.**
- 6. Promote use of blended cements**
- 7. Encourage recycling & waste mitigation.**
- 8. Customer education.**

**Applications in Concrete...**

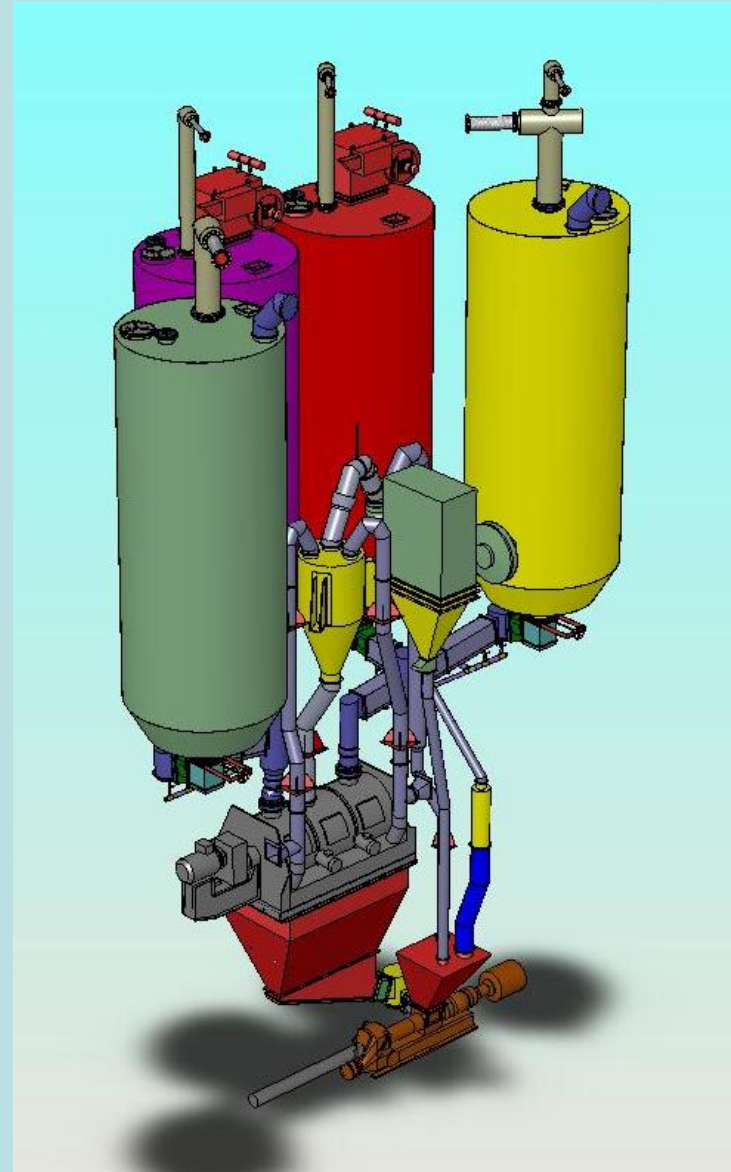
# **GBC's Process Changes**

- ✓ **Converted from wet to dry process in 1983.**
- ✓ **Modified to burn wood waste in 2004 - a carbon-neutral bio-fuel.**
- ✓ **Modified plant to capture waste heat for pre-calcining and for fuel drying, in 2005.**
- ✓ **Changed from open circuit milling to closed in 2008.**
- ✓ **Cement blending capacity added in 2009.**
- ✓ **Standard changed in 2010 to allow 10% of non-kiln material (NZS 3122).**

# Auckland Blending plant



- Can blend up to four components simultaneously



# Blends

- **Green Star rated – 20% non-kiln material**
- **Precast Green Star – 15% non-kiln**
- **Low Heat**
- **Chemically resistant**
- **Marine durability**
- **Self-Compacting mixes**
- **Masonry**
- **Hollow-core flooring**
- **Stabilization and grouting**
- **Other?**

# CO<sub>2</sub> Cost Reduction

- **Fuel efficiency**
  - Capture waste heat
  - Use pre-burnt limestone from waste products - (Fly Ash or KOBM Slag)
  - Pre-dry fuel
- **Bio-fuel**
  - Wood waste – a Carbon Neutral fuel (Kyoto Protocol)
- **Product uniformity**
  - Minimize cement contents



**Left to rot, wood waste forms methane with 23 times the global warming effect of CO<sub>2</sub>**

**Bio-fuel is Carbon-Neutral under the Kyoto Protocol.**

**Geopolymer Concrete test slabs**



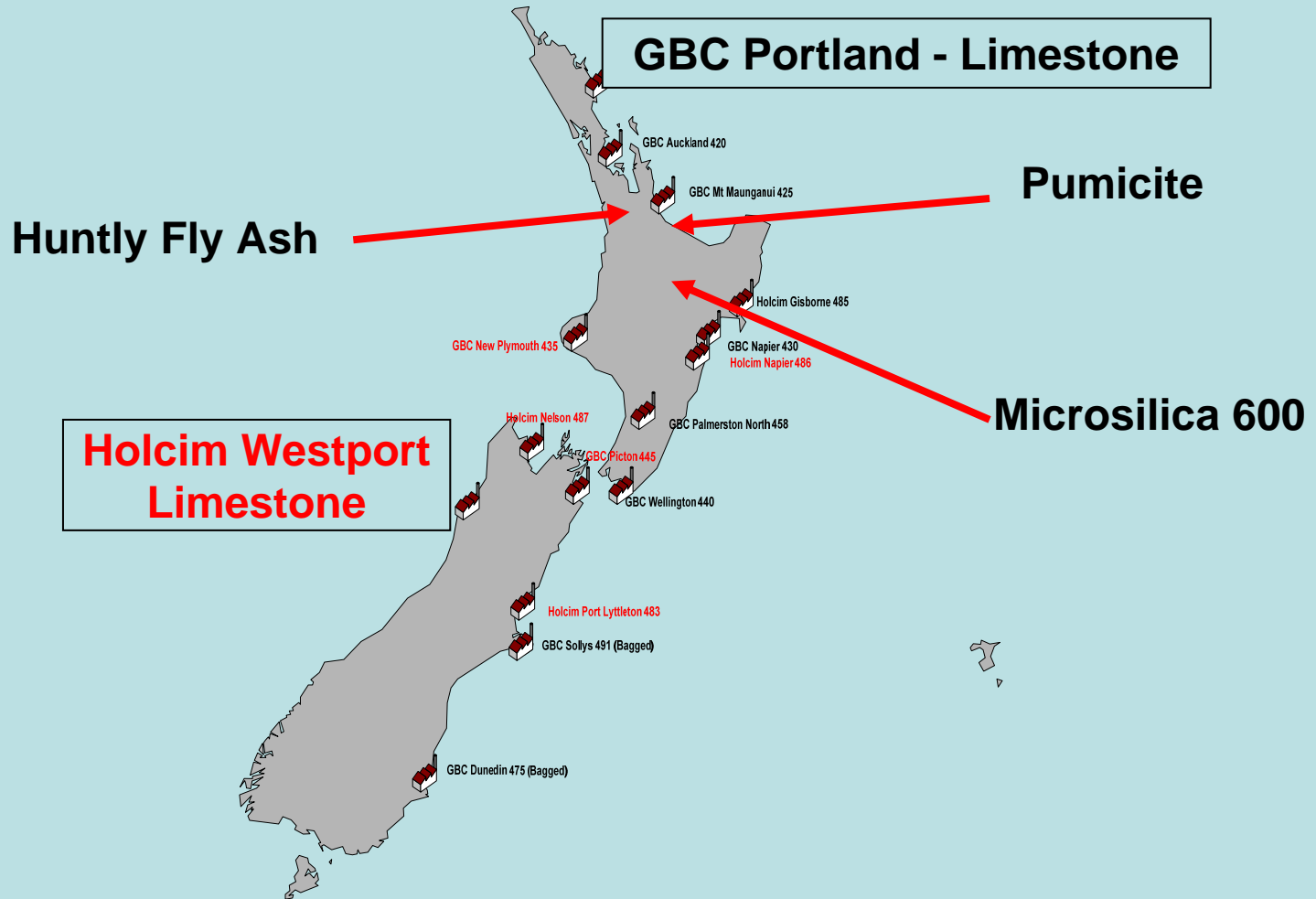


**Wood waste supplements the pre-calciner heating.  
Can burn treated timber & laminated wood veneer.**

# Locally Available Pozzolans

- **Huntly Fly Ash – Class C**
- **Amorphous geothermal micro-silica**
- **Pumicite**
- **Limestone**
- **Diatomaceous earth**
- **Powdered glass**

# Available New Zealand SCM's





# Microsilica New Zealand



**The Rotorua Quarry**

# Pumicite – a by-product of pumice quarrying



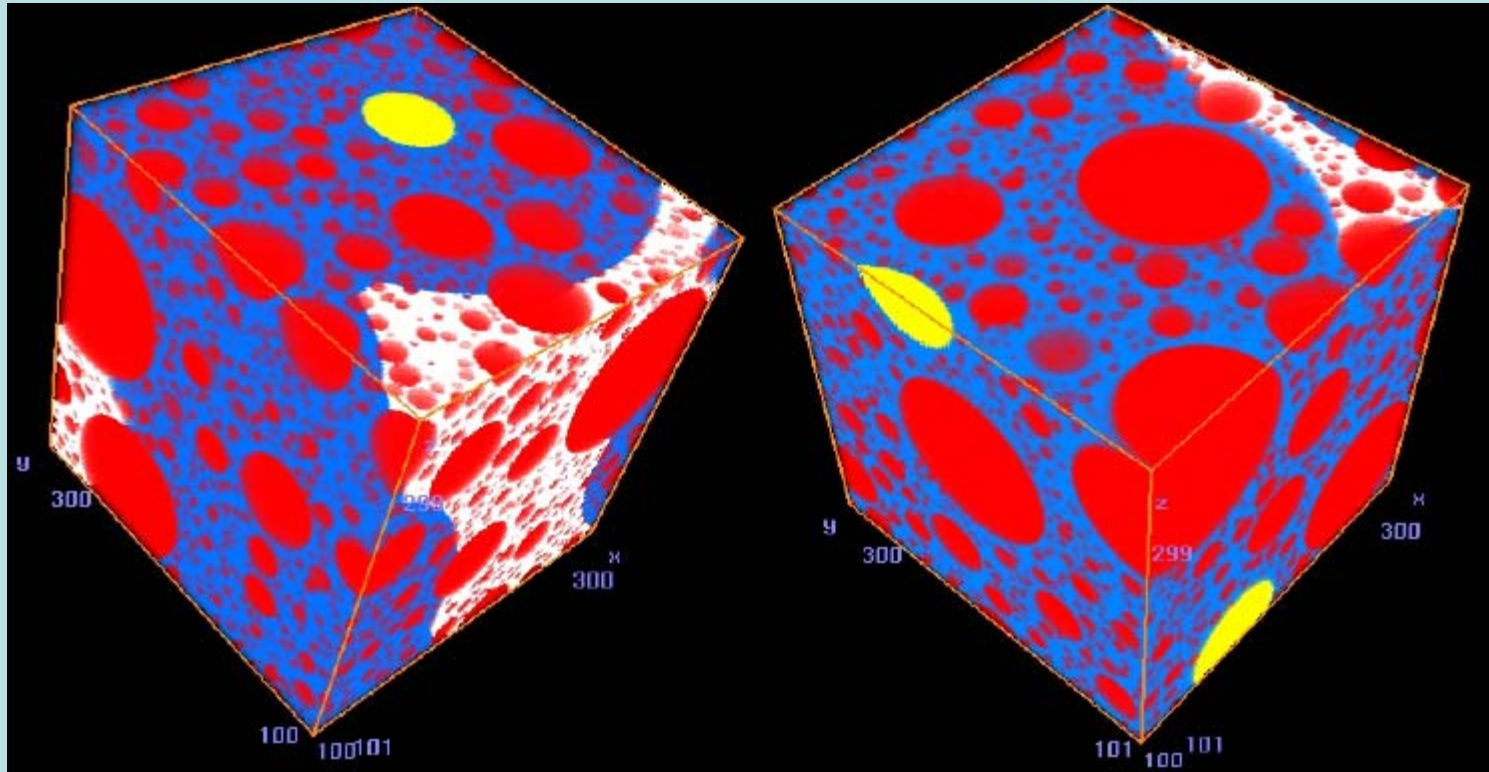
**Pumice Quarry – Te Puke**

# Why the Interest in Pumice?

- **Reduced precast concrete transport and erection costs – greater productivity.**
- **Improved durability – internal curing, etc.**
- **Avoid the high cost of imported LWA.**
- **Eliminate high Carbon Footprint of imported, kiln-derived LWA.**
- **A more sustainable product for NZ.**
- **Self-curing concrete – efficient use of water.**



# Internal Water Curing



Bentz et al. (2005)



## **A Lightweight Concrete Stadium**





# Waste Recycling



**New Zealand has an excess amount of waste paint that was destined to end up in landfill...**

# PaintCrete Site Trials





# Amazing properties!



# Concrete evidence that recycling pays dividends.



Golden Bay Cement and Firth Industries have joined with 3R and Resene's PaintWise programme to develop Paintcrete®. Waste paint previously destined for landfills will be used in various cement based applications. In other words it becomes a filler in concrete – and perfectly suitable for filling masonry walls (where the nasty mauve paint chosen by your colour-blind partner won't be noticed).

Extracting value from the  
most unlikely places.





## **Inorganic Polymer Concrete**

**A new cement with low CO<sub>2</sub> Emissions...**





**Structurally adequate, but the durability is still suspect.**





**Fibre Reinforced SCC**





**A waste-water treatment tank in fibre-reinforced SCC.**

**Three components:**

- **Outer shell**
- **Inner baffles**
- **Top**



# **PRESSS Technology**

## **Auckland Airport Parking Building**

- **Low seismic damage, fast to erect and relocatable.**
- **Included in Design Standards & Taught in Universities.**



**Matakōhe – Limestone Island  
Whangarei Harbour**









**Old quarries become ideal Kiwi sanctuaries.**



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