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Our Mission

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Designing with Natural Processes; building as if you are part of nature.

By Carolyn Dry, Ph.D.

President, Natural Process Design, Inc.

Emeritus Professor of Architecture, University of Illinois

I have developed several materials/technologies that address the issue of how to build with the natural processes of nature and concurrently take up some of the effluents of our fossil fuel/CFC economy and prepare for a new non fossil fuel/CFC economy.

Nature builds with 1) cheap often recycled materials, 2) that can self repair, 3) self sense, 4) return to the
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sink of materials by recycling and, 5) often improve the environment and 6) self form. Further this paradigm is used to sequester the effluents of our fossil fuel economy. Examples of each topic and materials developed are:

- 1) Fly ash is the waste product of burning coal and contains many heavy metals and is largely carbon. I developed a way of making it into building panels of nearly all ash so that these metals are sequestered and do not leach out to pollute the environment.

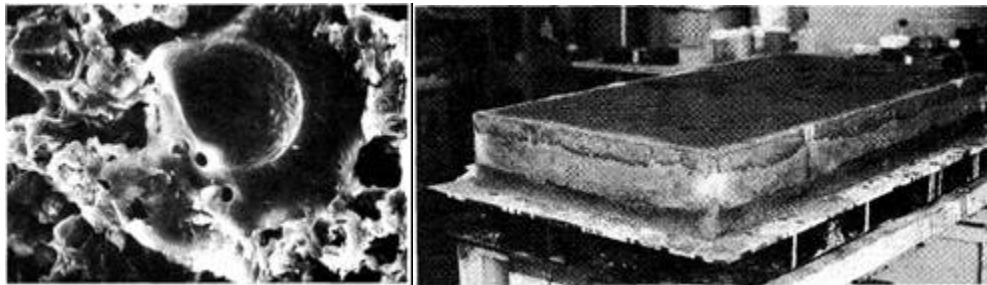


Figure 1) Left are the fly ash spheres and right is one of my fabricated panels

- 2) The making of cement produces 8-10% of the world's CO_2 . I developed a self repairing cement/concrete so that less cement would need to be replaced. We made four full size bridges of this. Also, our polymer composites made of

graphite from oil are self repairing. In a project just completed for the US Air Force, it is expected that airplane composite portion of the airplane fuselage can be 30% lighter than without self repair. That would save large amounts of fuel and CO2 emissions. (an airplane trip uses three times the gas for a car trip of the same distance) Currently a large aerospace company is developing this technology with us

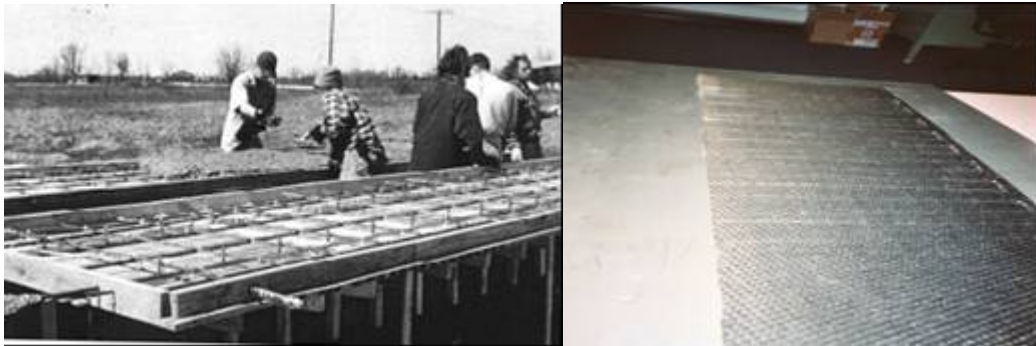


Figure 2) Left is self repairing concrete bridges and right is self repairing airplane wing

- 3) These self repairing materials can be self sensing to assess the state of damage and repair. Further, these self repairing and self sensing materials could help materials survive longer

and thus reduce the use of oil. We made self repairing and sensing components for airplanes such as wings which we are now commercializing.

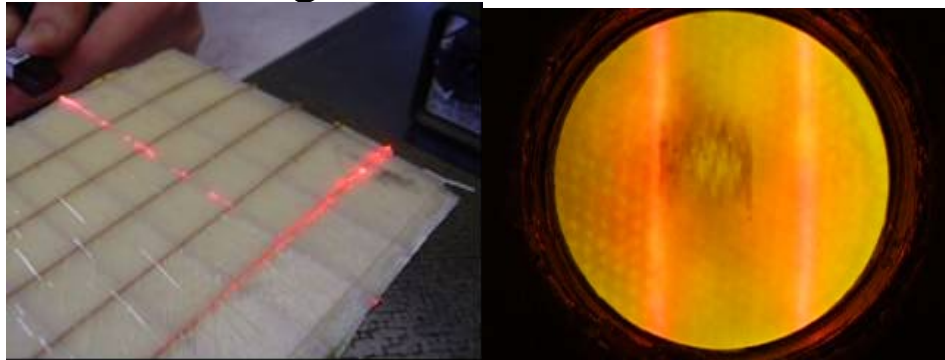


Figure 3) Left is sensing system and right is the damages or bruised composite with red repair material showing as color

- 4) Concrete girders have embedded in them high tension metal rods that can break and blow the whole girder and surrounding structures apart when cut, so I developed a way of dismantling them so they can be taken out and the rest of the bridge remain intact..



Figure 4) a photo of the girders being fabricated

- 5) Much of the CO₂ released during calcining of cement can be taken up by the concrete over time. I developed a paint that utilizes this ability and speeds it up. It can be used on highways or buildings. It takes up CO₂ in roads at the source, automobile tailpipes, and the reaction strengthens and repairs the concrete and extends its lifetime while improving the environment by taking up CO₂.

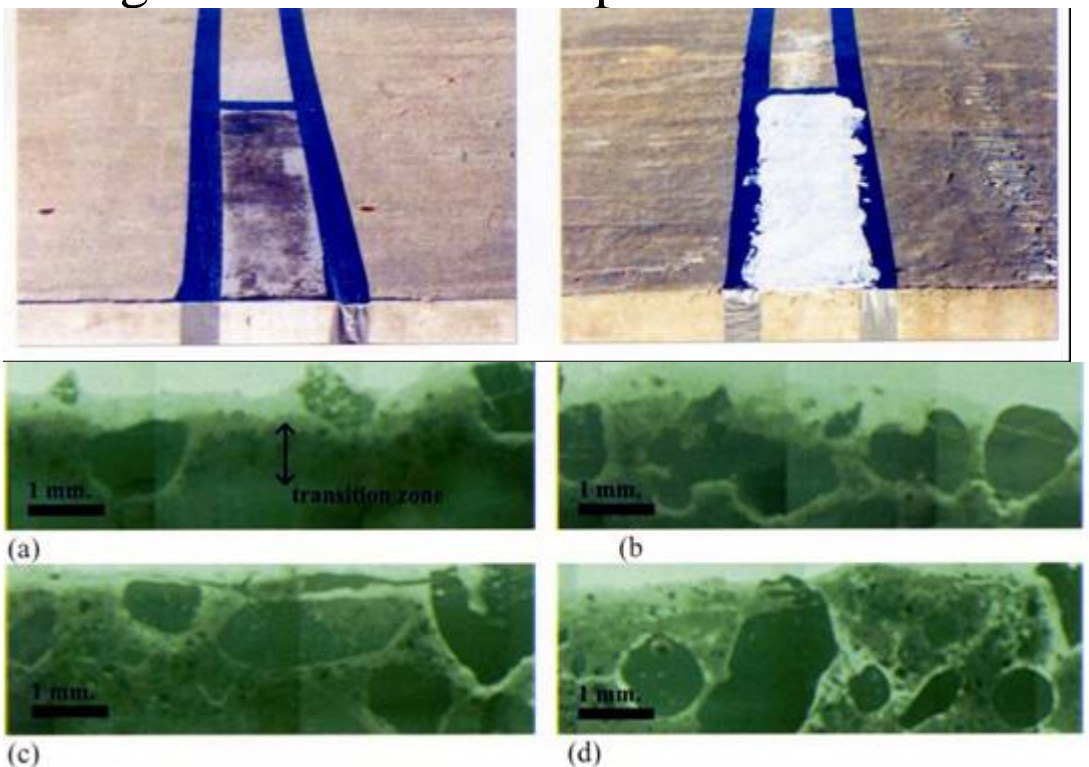


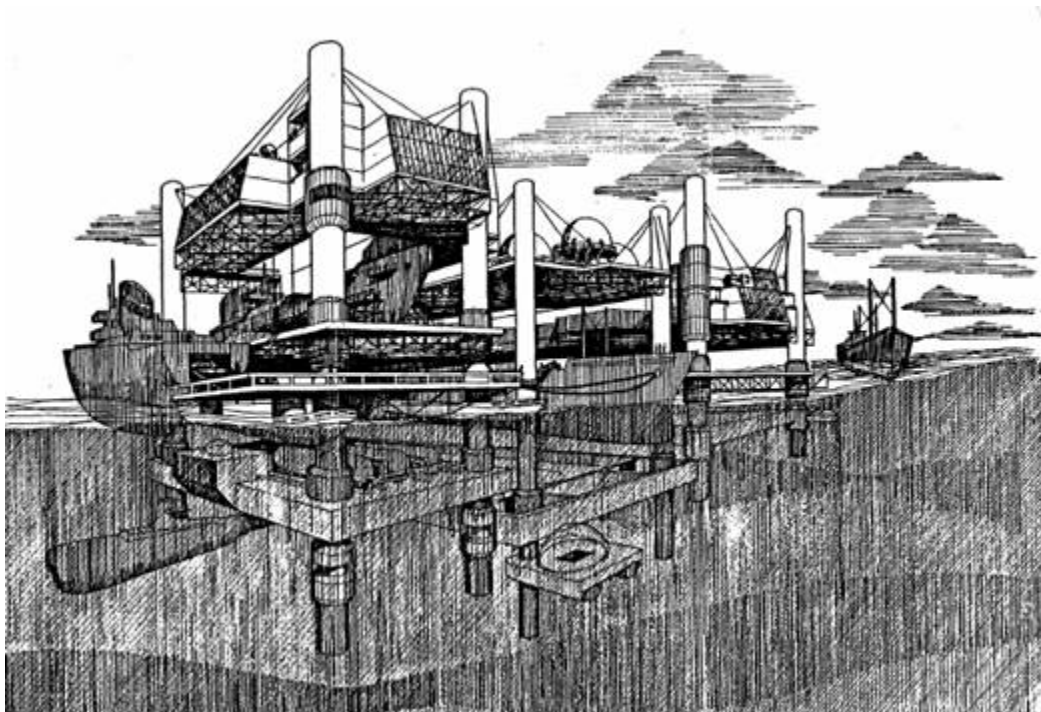
Figure 5) Top are the bridges with CO₂ sequestering coatings and below is a slice of the concrete showing how far the CO₂ penetrated.

A similar concrete material we developed can take up other greenhouse gases such as NOX and sulfur dioxide and CFC gases.

- 6) Nature self forms materials by a process involving the uniting of a property of the environment with a property of the material. In my first project I united all of these aspects into one system. Based on a technology developed by another researcher, Wolf Hilbertz, I worked on a self forming system that uses the chemistry of seawater to make a structure in the ocean and went on to develop the idea for an entire port using the chemistry of seawater. That project was a good example of self forming. The electrolytic sea water can carry an electrical charge and move calcium ions onto the charged structure. This forms a coral or bone like material.

Based on the fact that we evolved from seawater, our lymph is exactly like seawater in chemical composition, so I looked to the human

body for inspiration. This bone like structure in the ocean repairs itself by more stress which pulls out more calcium from the ocean, like your ribs repair by using the calcium in lymph. The ports “nerves” can sense using charged ions going over a membrane and can move parts like our muscles by using different chemical concentrations in water to make an osmotic pump.



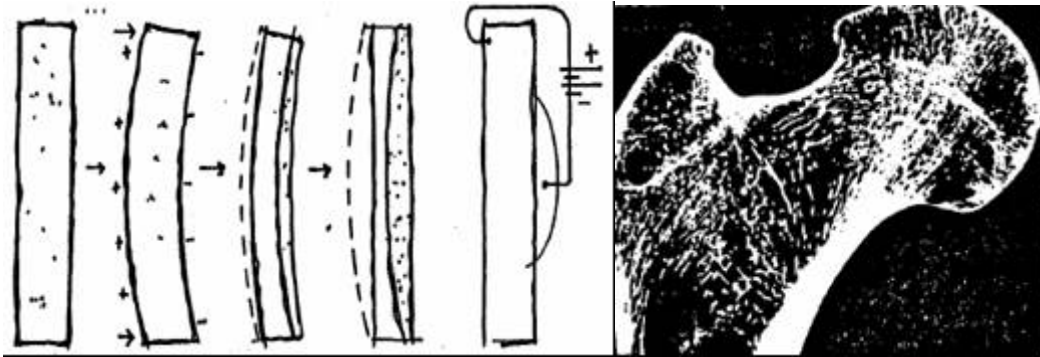


Figure 6) Top is a drawing of the ocean port which performs all functions by using the chemistry of seawater, lower left shows how the port structure repairs, like bone, using electrical charges, right is a bone.

7) Following the bone analogy I also developed a cement and polymer material that forms like bone in which the polymer forms a template for the cement to follow.

It has the advantages of the hard cement which is strong and the plastic which can bend.

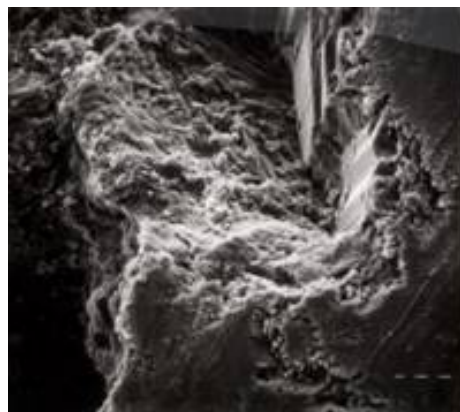


Figure 7) This is a microscope photo of the cement/polymer material.

Some of my recent work to look past a fossil fuel/CFC economy but still using the parading of building with natural processes are:

- a) projects in self repairing hydrogen tanks, wind turbine blades
- b) coatings and materials that take up all manner of greenhouse gases
- c) integrated appliances including energy production and refrigeration;
- d) two unique car propulsion systems, one airplane propulsion system,

The earth was formed in the same event with Mars, Venus, and the other planets from the big bang. So they were very similar in composition but not size. Currently Venus is very hot and Mars is cold and they cycle in temperature widely in one day. The earth has evolved differently to have a stable moderate temperature in a small range with a

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breathable atmosphere, it can support animal life. How did this happen? Our atmosphere of gases from the center of the earth, emitted from volcanoes, was toxic, full of methane, sulfur and CO₂. It was incredibly hot with very large heat fluctuations. But, gravity held in the atmosphere and eventually plant life was formed from bacteria and transformed the atmosphere from such a reducing one to an oxygenated one that animals could breathe. This atmosphere insulated the earth and stabilized the climate to a small range of steady temperatures that were cool and warm enough to support animal life. Now, we are driving that evolution of the atmosphere backwards with too much reducing gas such as CO₂ and against our own survival as animals. Also an ozone layer formed which protects against ultraviolet radiation and a large hole is developing which threatens the phytoplankton which produce some 50% of the worlds oxygen we breathe and sequesters 50% of the worlds CO₂. It is thought to be as serious as the build up of greenhouse gases from burning fossil fuels.

The solution to the problem of too much CO₂ is to plant more trees, stop cutting them down, and stop burning old plants (fossil fuels) which produces so much CO₂ and take up the effluents of this fossil fuel and CFC Ozone depleting economy.

Input for the National Academy of Environmental Design
Teleconference

Carolyn Dry, Ph.D.

Natural Process Design, Inc.

1 It is not true there are no new solutions that are market ready

2 Yes global warming is a systems problem but requires surgical, targeted interventions. It is not a consumer problem but one of industry. Given better choices of materials people will do the right thing. As an analogy, the Clinton medical care broad program failed but when they went after the key component of health care, smoking related illnesses and the cause- false advertising and promoted addiction, then they were somewhat successful in starting to reduce costs of

medical insurance. To go after key points in global warming we should address such factors as cement production which produces 7-10% of worlds CO₂, and revisit cfcs and coolants because the ozone hole problem is not solved and still growing and the increased UV radiation is causing a die off of phytoplankton in antarctica which sequester some 50% of the CO₂ and produce some 50% of worlds oxygen. The problem of global warming is an oxygen problem and well as CO₂ and an ozone problem

4 Small businesses do and will generate most innovations and jobs in the US but receive very little government support compared to banks, roads and universities.

5 To find the solutions to an ecological problem, one must understand the ecological issues such as our planetary history; evolution of the atmosphere and why it evolved. In a nutshell, the earth had the same atmosphere as mars and venus after the big bang but plant life changed the atmosphere from having mainly CO₂ and no oxygen to 77% nitrogen, O₂-21 %, and only .3% CO₂. Most of the CO₂ is sequestered in dead plants such as oil, gas and coal. The temperatures on Mars are very cold and Venus very hot with large diurnal swings whereas on earth the

temperature is relatively constant within a narrower range, all due to the earth's shielding atmosphere

We could solve a majority of our global warming/atmospheric reversal problem in a few years by planting more- vegetation/trees- That is if everyone erased their own global warming footprint and we do the other half by using algae in sewage ponds to replace the action of algal phytoplankton

Finally people should be rewarded for turning down furnaces and conserving everywhere but I think that in the US it is easier to be proactive and plant trees; also taxing industry CO2 emissions is a great idea.

Barriers to solving global warming are:

1 ignorance of quantifiable issues, no priorities (every action seems equal but effects are not at all equal) and our planetary history

2 acceptance of guilt by the populace which does not look to industrial materials and processes as the problem; some examples are ozone depleting coolants and cement

production. Also groups that take up the motivation to be green by consumers without educating them about real causes, where solutions are. and promoting informed consumer action.

3 misunderstandings of total energy costs of some biofuels, nuclear energy
