

# Inquiring Minds topic – 5 December 2014

Albert Myers, Moderator

## Carbon Dioxide Chemistry

With carbon dioxide the “prime suspect” in global warming a word about its chemistry may be in order. With water as an analog, we know its existence in three phases: a liquid, a solid (ice) and a vapor (steam). Carbon dioxide, on the other hand seems to have only two phases: we know it as a solid (dry ice) and we know it as a gas resulting from the combustion of carbon containing fuels. Carbon dioxide will become a liquid, however, if it is cooled to room temperature and if its pressure is increased to nearly 1000 pounds per square inch.

All discussion of carbon dioxide “sequestration” assumes that it will be managed as a high-pressure liquid pumped into deep ocean trenches, abandon oil fields, etc.

Coal burning electric generation must be the first target. Here is the major source of carbon dioxide generation and the sources are isolated—unlike the carbon dioxide emissions from vehicles. Coal is mostly carbon with an atomic weight of 12; while carbon dioxide has a molecular weight of 44. The combustion of 12 pounds of coal (if it were all carbon) results in 44 pounds of carbon dioxide. (The experts writing on this subject seem to agree—each pound of coal burned results in two pounds of carbon dioxide.) In just the US, about 2000 million metric tons of carbon dioxide is generated each year from coal burning electric power plants. The energy required to compress and cool the carbon dioxide is significant. A 600 megawatt power plant becomes a 475 megawatt power plant if the energy required to treat the carbon dioxide is included. As water is 62.4 pounds per cubic foot, liquid carbon dioxide (at 1000 pounds pressure) is about 48 pounds per cubic foot. If a barrel will hold five cubic feet; then the sequestration of carbon dioxide from US coal burning will force the management of about forty million barrels of carbon dioxide liquid each day! Currently the atmosphere has .04% carbon dioxide—400 parts per million. If a leak occurred in a pipe line carrying high pressure carbon dioxide, and the local concentration became 8%, people in the area would die of suffocation.

The total liquid fuel oil and gasoline consumed each day in the US (at atmospheric pressure) is about twenty million barrels. Think of the infrastructure used to manage these 20 million barrels: the tank trucks, storage tanks, pipe lines etc. Now consider twice this quantity of material at one thousand pounds per square inch! Our political leaders are forced to pursue the absurd—they can’t avoid the carbon dioxide link to global warming; yet there are 80,000 coalminers in 25 states whose interests can’t be ignored. An equal number of ancillary workers also derive their income from coal—rail and barge operators, truckers, etc.

President Barack Obama’s June 2 proposal to cut pollution from coal plants has two obvious hypocrisies: Carbon dioxide is included with other coal-burning stack gases as a source of asthma. This is absurd—unless carbon dioxide as a fertilizer forces the increase in the growth of rag weed and the pollen drives the lung problems. The second bit of legerdemain is the use of 2005 as the reference year against which there is a proposed 30% carbon dioxide reduction by 2030. Faced with an ageing population of coal facilities and an increase in the availability of natural gas at reasonable prices, coal fired energy has already been decreased by 15%. If everything works out according to plan, world-wide emissions will be reduced by 1-2%.

If the detritus from our energy producing activity must be managed, there is no question: nuclear waste management is a piece of cake when the alternative is carbon dioxide management. Here is the compounding problem—coal has constituencies—nuclear does not.

(Professor Richard Hill of the University of Maine wrote this article and would be glad to hear from readers with conflicting data—rchill@maine.edu)

## **Dr. Hill offered this piece for local readers in DownEast Maine:**

Let's assume a developer wishes to establish a facility five miles up the Bangor Road. The insurance carrier demands a local hydrant that can produce a specified flow and residual pressure. The engineers working for the Ellsworth Water District know the elevation of the water in the standpipe and the size of all connected piping. With this information the engineers can predetermine the performance of the proposed hydrant. And they will get it right because a British scientist, Osborne Reynolds, in the 1890s established the rules of fluid flow in a pipe. There are only five variables: pipe diameter, and length, viscosity, density and velocity of the fluid. There is also a correction for pipe roughness. That is all there is to it. If a bathroom exhaust fan is to be installed and duct work is needed to get the exhaust gas outdoors; Reynolds is right there telling you about the needed duct diameter and length. I looked up "climate science" and found nearly one hundred variables. For starters: Dobson unit, Kelvin waves, arctic oscillation, incident energy, attenuation coefficients for gases and particles in the atmosphere etc; the list goes on up to about one hundred!!! There will never be an Osborne Reynolds to rationalize this stuff.

The Intergovernmental Panel on Climate Change has identified 73 climate models. Starting in 1975 and projecting these models to the present all seventy three came in with temperatures higher than the current temperatures as measured by satellites and weather balloons. All 73 models got it wrong. Here is what spooks the analysis. The basics are clear. Carbon dioxide absorbs some of the long wave back radiation from the earth to outer space. This captured radiation tends to warm the surface of the earth. In turn, this increase in earth temperature tends to evaporate more moisture. Moisture (humidity) in the atmosphere is a much stronger global warming gas than is the carbon dioxide. The bulk of global warming projections depend on this feed-back loop between carbon dioxide and water vapor. Big trouble: that moisture also forms clouds. Some reflect incoming sunlight and cool the earth—others tend to act as a blanket and warm the earth. There is Nobel Prize out there for the person to show the role clouds play in the energy balance of the earth.

Global warming is not the only ambiguity in our future. For the past quarter century we have been running an annual 500 billion dollar trade deficit. We buy more stuff from abroad than we sell abroad. Great dollar balances are being accrued by foreigners. What happens if they decide to "cash in." As the current generation is about to enter retirement, there is no way the medical resources can be mustered to provide to them the care now lavished on the current retirees.

Mankind's interference in the nitrogen cycle through the use of synthetic fertilizers is unequaled in any other bio-chemical cycle. Our current draw-down and pollution of aquifers should be a major concern. The construction boom in China has forced much salinization, erosion, desertification, and destruction of crop land. The current Chinese agriculturally available land, per person, is less than the average in Bangladesh. The medical literature continues to report the dangers of antibiotic resistant strains of bacteria. Many say that the problem of global warming will trump all these concerns.—I don't believe it. It is exaggeration to say the least; to debate the appropriateness of a particular oil pipeline on the basis of its role in global warming is absurd. The menu of legitimate concerns is broad and deep. The Republicans are working on the base for the next election by bashing "Obamacare" while the Democrats are working on their base by pushing an increase in the minimum wage—no one is minding the store.

In 1712, when Thomas Newcomen developed a steam engine to pump the water from British coal mines, he set the world on a tread mill, and we don't know how to get off. We technical people can guarantee the performance of a hydrant five miles up the Bangor road; but the health-care management of an ageing population? Don't ask!

"Too many people, demanding too many services from a planet that is too small"

Check versions of this statement on your computer—you will find over one hundred million hits.

# **Suggested Issues to Discuss:**

**Critique the reasoning behind the argument that carbon dioxide sequestration should not be the solution.**

**Propose a solution to job loss due to shutting down use of coal.**

**Is nuclear power generation the answer?**

**Is the role of clouds of great importance?**

**Is America's trade deficit a larger problem, and what ought to be done about it?**

**Is human interference in the nitrogen cycle a major problem? If so, how should this be addressed?**

**What about continued clearing of land for "development"?  
What can be done?**

**What about the dangers of antibiotic resistant strains of bacteria? What should be done?**

**Professor Hill wrote "Too many people, demanding too many services from a planet that is too small" - is he correct? If so, what must happen?**