THE CONSULTANT

The Newsletter of the IEEE Consultants Network of Long Island

Volume 24, Number 6 *June 2007*

Chairman's Corner — *John Dunn, President, Ambertec, Inc.*

In 1971, while I was working overtime while visiting this company in Massachusetts, the word "late" had come to have real meaning.

That company's building services were apparently being done by just one man whom I would see mopping over there and sweeping over here and emptying baskets and so forth. However, when ten PM came, he stopped working because it was time for his lunch.

I watched him take out two huge lunch pails. He opened the first and brought forth an absolutely beautiful linen tablecloth which he very carefully spread out across one vacant workbench. He smoothed it out so very, very carefully while aligning its edges to match those of the bench. Watchmakers could have learned from the precision of those moves.

Then from that same lunch pail, he took out several matching linen napkins which he placed with great care on the tablecloth along with condiment dispensers of several kinds and a variety of silverware utensils, some of which I didn't recognize.

Next, he opened the second lunch pail and extracted from there, a lobster dinner.

He set everything up and proceeded not just to have lunch, but to partake of an exquisite epicurean experience!! I have never seen anyone enjoy a meal with such.... Frankly, words fail me at this point.

Thirty-six years later, I can still see this fellow in my mind's eye and let me mention, he was of slender build, in no way overweight at all.

Now, I have seen people's eyes glaze over a little bit at the thought of some favorite food, be it prime rib, or corn on the cob or watermelon or what have you, but I myself have never had that kind of reaction to any such stimulus. I can only look on such things with awe and wonder.

Life offers each of us the opportunities of choice and pleasures, but how many of us rise to the level this man taught to me on that occasion?

Meetings

June 2007

Topic: "Rail Voltage Ripple Estimation"
Speaker: Mr. John Dunn, Ambertec, Inc., Merrick, NY

John offered to send a copy of the presentation to those who request it. E-mail: ambertec@ieee.org.

We did not continue our discussion with Dave Allen about a new directory and alternative advertising methods. That was left for a future meeting.

We all agreed to inform the members about seminars and other items that might be of interest. E-mail: members@consult-li.com.

July 2007

7:00 PM, Wednesday, July 11, not the customary first Wednesday of the month, because of the Independence Day celebration.

Place: Briarcliffe College, 1055 Stewart Avenue, Bethpage, NY
See website for directions: www.consult-li.com

Topic: "Network(ing?) Meeting" chaired by Mr. John Dunn of Ambertec, Inc., Merrick, NY.

Irwin Weitman will reprise "Contracts With a Bite".

Light refreshments will be served. Admission is free (no charge), and no pre-registration is required. For more information, contact Chairman John Dunn at (516)378-2149 or e-mail ambertec@ieee.org.

Other Meetings

Consult the Events Calendars on the Section website: www.ieee.li and the LICN site: www.consult-li.com.

THE CONSULTANT is published monthly by the IEEE Long Island Consultants Network and is available free of charge to its members.
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Deadlines: Flexible
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Playing with Fire --- *Carl E. Schwab*

The writer has written articles extolling the virtues of methane gas or CH4 as a safe, near perfect, renewable fuel. Much of this comes about because CH4 easily hydrates (forms clathrate) with water. The CH4 is trapped in a cage of H2O. Clathrate means cage in Greek. As a result there are huge quantities CH4 clathrate in oceans, lakes, in coal layers etc. The usual reason for so much CH4 and CO2 is that they are the result of the decomposition of carbon-based living organisms, but in the case we are about to explain the source of the CH4 and CO2 is from volcanic leakage into a deep lake.

This particular article talks about Lake Kivu. Where is Lake Kivu?

Geography

Lake Kivu covers a total surface area of some 2700 km² and stands at a height of 1460 meters above sea level. The lake bed sits upon a rift valley that is slowly being pulled apart, causing volcanic activity in the area. The lake is surrounded by majestic mountains making it a magnificent sight.

A large island, Idjwi, lies in the lake, while settlements on its shore include Bukavu, Kabare, Kalehe, Sake and Goma in Congo and Gisenyi, Kibuye and Cyangugu in Rwanda.

Lake Kivu is one of three known exploding lakes, along with Cameroonian Lake Nyos and Lake Monoun, that experience violent lake overturns. Analysis of Lake Kivu's geological history indicates a periodic massive biological extinction about every 1,000 years. The trigger for lake overturns in Lake Kivu's case is unknown but periodic volcanic activity is suspected. The gaseous chemical composition of exploding lakes is unique to each lake; in Lake Kivu's case, methane and carbon dioxide and a trace of hydrogen sulfide, H2S, due to lake water interaction with a volcano. The risk from a possible Lake Kivu overturn would be catastrophic, dwarfing other documented lake overturns at Lake Nyos, since approximately 2 million people live in the lake basin.

The risk posed by Lake Kivu began to be understood during the analysis of more recent events at Lake Nyos. Lake Kivu's methane was only originally thought to be a cheap natural resource for export and the generation of cheap power. Once the mechanisms that caused lake overturns began to be understood, so did the risk the lake posed to the local population.

An experimental vent pipe was installed at Lake Nyos in 2001 to degas the deep water, but such a solution for the much larger Lake Kivu would be extremely expensive, running into millions of dollars. No plan has been initiated to reduce the risk posed by Lake Kivu. And the solution would be to flare the CH4,(producing more CO2) and vent the CO2 from the lake along with the H2S, all in the sole interest of safety.

Methane Extraction

Lake Kivu has recently been determined to have approximately 55 billion cubic meters of dissolved methane gas at a depth of 300 meters. Extraction of the gas is currently being done on a small scale, with the extracted gas being used to run boilers at a brewery. As far as large-scale exploitation of this resource is concerned, the Rwandan government has signed an $80 million deal with an international consortium to produce methane from the lake. Extraction is said to be extremely cost effective and simple because once the gas-rich water is pumped up the dissolved gases (primarily carbon dioxide, hydrogen sulphide, and methane) begin to bubble out as the water reaches lower pressure. This project is expected to increase Rwanda's energy generation capability by as much as 20 times and will enable Rwanda to sell electricity to neighbouring African countries.

How To Make a Win-Win Situation?

To make this a win-win situation we need to efficiently extract BOTH the CH4 and the CO2 and find some use for the H2S. Removal of gases makes Lake Kivu secure against the nearly freakish overturning phenomena. The CO2 is very saleable for deep treatment of producing oil wells to extract nearly all the oil from a producing well.

Since all of the gasses are hydrated at about a 300 meters depth in Lake Kivu, the first step is a low cost simple method for extracting the combined gasses and then a low cost simple method of separating them.

The first step is to draw the town and city waters from Lake Kivu, BUT draw from below 300 meters. As this water is drawn to the surface the CH4, CO2 and H2S will boil off as the pressure is reduced and they can be stored in appropriate pressure holding tanks. If the municipal water requirements are met and more CH4 and CO2 is wanted, then the excess water (with CH4 and CO2 removed) is returned to the lake.

Separating CH4 and CO2

Although both of the molecules have a carbon atom, their molecular weight and size is significantly different. CH4 weighs 12+4=16 while CO2 weighs 12+16+16=44. Ch4 is lighter than air and CO2 is heavier than air. Also the hydrogen atom is very small, relatively, and the oxygen atom quite large. So we have two physical characteristics, weight and size, on which selection can be based.

The H2S, by the way, weighs 2+32=34 and in size is between CH4 and CO2.

There are two accepted commercial practices used to separate CH4 and CO2 as the presence of both in oil production is common. The first is to use centrifugal force separation of a centrifuge and the second is micro-screen filtering.

The main advantage of the micro-screen filtering is that in the gaseous state little energy is needed to pass the gas through a micro-screen. In the simplest case a single filter will reliably separate CH4 from CO2. In theory, an additional filter could separate any H2S. The amount of H2S is at most a few percent and it has no significant commercial value. However, H2S (that's the rotten egg odor) has been used to warn of the presence of CH4 or CO2, both of which are odorless.

The advantage of the centrifuge is that it can separate CH4, CO2, and H2S. Again for the oil production business such centrifuges already exist. The negative point is that they require mechanical rotating drive power to spin the centrifuge at high speeds.

The way this is often handled is to use a small auxiliary internal combustion engine burning some of the extracted CH4 to provide the needed mechanical drive power.

Conclusion

Rwanda is a dynamic country, which is trying to speed up development after disastrous internal conflicts. Unfortunately, this attempt is made difficult by serious deficiencies in the availability of energy resources. Access to energy is still generally through the traditional resource: wood. This custom has led Rwanda to destroy the principle part of its non-protected forests and to find itself confronted with a desperate environmental situation. If nothing is done, this massive deforestation will automatically come to an end in the coming years through lack of wooded areas. The extraction of methane, a cheap and practically inexhaustible energy source, should help to safeguard Rwanda's natural resources, currently threatened by an intensive and uncontrolled over-exploitation.

The technology seems well in hand. Perhaps the political problems are the more difficult to solve. It would seem that an organization like the UN should be interested in improving the lot of the citizens of Rwanda by endorsing such a project. Sadly the UN's track record is not that good, but maybe things can be changed.

Summing Up — *Richard LaRosa, sealevelcontrol.com*

Sealevelcontrol.com is a DBA registered in Nassau County to cover R&D aimed at retarding the melting of polar ice sheets in order to slow down the global rise of sea level. The initial idea was to extract power from certain ocean currents in order to slow them down. This would reduce the rate of heat transport from the tropics to the poles. The Florida Current and the Gulf Stream were the prime targets because they help to transport heat to the Greenland ice sheet in the Arctic. One LICN member was concerned that this would leave more heat behind in the tropics and thereby increase the frequency or intensity of hurricanes. I considered this a secondary problem to be considered in the future.

However,I was recruited to replace an author who had been contributing a chapter to a book on Macro-Engineering. Hurricane Katrina had intervened and made it impossible for him to complete his work. An important part of my chapter was a crude and approximate estimate of the power supplied to the North Atlantic Subtropical Gyre by the wind and the Earth's rotation. The Florida Current and the Gulf Stream are the western boundary currents of this gyre. My calculations indicated that extracting from these currents continuously year-round electric power equal to the peak summer demands of the New York City and Long Island areas would slow the currents by about 10%. So reducing the ocean current heat transport from Equator to North Pole is well within the realm of possibility, but after Rita and Wilma struck, this began to look like a bad idea.

COLD WATER

The publication deadline was closing in and I would have to satisfy it with a different idea. How about upwelling 5°C water from 1000-meter depth in the tropics? This would replace some of the 30°C surface water carried north by the Florida Current and Gulf Stream. Some calculations showed that to do any good, it would be necessary to upwell about one million cubic meters per second. Ouch! A more convenient unit for these large flows is the Sverdrup, named for the famous oceanographer, Harald Sverdrup, and abbreviated Sv. The Florida Current transport is about 25 Sv, so we need to upwell 1/25 of the Florida Current.

This must be pumped up through vertical pipes whose length is 1000 m. The cold water in the pipes is heavier than the average of the water outside the pipes. Lifting this differential weight and overcoming pipe friction requires at least 15 GW of power, and as most of us know, it is prudent to double this value to allow for all the additional requirements that become evident. For example, the three referees who reviewed my chapter recommended that it be thrown out because, as they correctly pointed out, the heavy cold water would form a plume that would sink right back down to the level from whence the cold water came. The editor asked me if I could fix the problem. One of the referees had mentioned that some form of containment was required, which gave me the idea to discharge the cold water through a long perforated hose. The power required for this discharge diffuser is one of the reasons for doubling the 15 GW estimate. I have yet to do a detailed design of the discharge hose and estimate the pump power that it actually requires.

I already knew that the Florida Current-Gulf Stream system could not supply 30 GW of continuous power without severe slowing. Supplying power from fossil fuel or nuclear fission would be an economic, environmental, and logistical disaster. Wave power and tidal power in this location are insufficient. Solar photovoltaic power would be too expensive, require impossible storage capacity to run through night darkness and cloudy weather, and there was no place to mount the PV panels. But there is another source of power for these pumps.

POWER SOURCE

The OPEC oil embargo got me involved in alternative energy sources, so I was familiar with ocean thermal energy conversion (OTEC), which can use the solar energy collected by the tropical ocean to operate a heat engine that uses the cold bottom water as a heat sink. Familiar I was, but not familiar enough to know that this technology was not ready for producing electric power on a commercial scale despite 90 years of development. Nor will it ever be ready, because the temperature differential between the surface water (27°C in winter) and the 5°C bottom water yields barely enough thermodynamic efficiency to bring the cold water up and pump it through the condenser heat exchanger, and run the other pumps and equipment necessary for the operation of the plant. There is no energy left over to sell.

In the case of the upwelling pump, the sole exported product is the cold water. Eliminating the requirement to export power results in minimum heat flow through the condenser and evaporator heat exchangers. This results in the smallest and least expensive machine. But it is still huge, expensive, and clunky. Can we find some benefit beyond surface cooling to justify this development?

OCEAN FOOD PRODUCTION

The euphotic zone is the layer of the ocean that receives enough sunlight to enable phytoplankton to produce oxygen in excess of their own respiration requirements. The phytoplankton are small floating plants that contain chlorophyll. Through photosynthesis, they combine water, carbon dioxide, nitrate ions, and phosphate ions to produce organic matter and oxygen. The organic matter is eaten by zooplankton, which in turn are eaten by larger creatures, and so on up the food chain. The nitrate and phosphate ions (or their nitrogen and phosphorus atoms) are called macronutrients, while small trace elements, like iron, are called micronutrients. Nutrients are plentiful in the ocean at 1000 m depth. However, they may be depleted in the euphotic zone if they cannot be replaced from below at an adequate rate.

The tropical ocean has a stable thermocline. That is, the top layer is heated by the Sun, expands, becomes less dense, and floats on top. The water is thermally stratified and vertical movement (circulation) is suppressed. Therefore nutrients are not brought from below by circulation into the euphotic zone to replace the nutrients consumed in photosynthesis. Some nutrients reach the euphotic zone through diffusion, which is a slower transport process than circulation. Diffusion cannot adequately supply nutrients for photosynthesis, so photosynthesis slows down.

There are many places in the ocean where natural upwelling supplies the euphotic zone with nutrients, but this does not happen in much of the tropical ocean, particularly in the Caribbean, where we might want to deploy OTEC-powered upwelling pumps to cool the Gulf of Mexico Loop Current, which feeds into the Florida Current. These pumps would bring nutrients up with the cold water and distribute them to the euphotic zone through the perforated discharge hoses. This might promote food production in an area of the tropical ocean that is presently not very productive. What is this worth?

The ocean fisheries are being exploited at an unsustainable rate, due to the demands for food by a steadily increasing human population. The problem is exacerbated by the wasteful methods employed by the fishing companies and individuals in their frantic competition with each other. Attempts are being made to establish more cooperative methods of sharing the catch. Lots of luck! Increasing production should help.

Supplying nutrients to the surface should increase the conversion of dissolved CO2 into protoplasm and oxygen. The downward drifting of this protoplasm and fecal material produced by creatures which eat the protoplasm is called the biological pump. Very little material reaches the ocean bottom. Bacteria in the material cause it to decay, and its nitrogen and phosphorus atoms are incorporated in nitrate and phosphate ions. This is called remineralization. If these ions are returned to the euphotic zone, they can be converted into protoplasm by photosynthesis. So we have a complicated feedback system with some protoplasm swimming away in the form of a fish that might be caught on a fishing line, some protoplasm actually sinking into the bottom and residing there almost permanently, and many in-between possibilities including endless recycling. This includes the production of oxygen from CO2 and water due to photosynthesis and the conversion of oxygen back into CO2 by decay.

The sinking of protoplasm through the "twilight zone" between the illuminated surface layer and the dark abyss has been somewhat of a mystery to oceanographers. It has been difficult to measure the downward particle sinking due to gravity because it is much slower than the horizontal water movement due to ocean currents. If a sediment trap is moored in place at some depth, the trap causes deflection of the streamlines around the trap, and turbulence. This makes it difficult to relate the rate of particles falling into the trap to the rate of particles falling through water that is undisturbed by a trap. Recent advances have been made with sediment traps that drift with the current at preset depth. The traps close after a preset time, the trap surfaces and is retrieved. Some consistent measurements have now been made of the particle flux attenuation with depth at several locations in the ocean. The attenuation rates depend on many variables, including the types of zooplankton at the location.

The above work on particle flux attenuation is only a small part of the activity of many workers. One would think that some of these experts could take a look at my idea of upwelling cold water and nutrients and tell me what's right or wrong, and suggest some improvements. Do I really want this? What if the person doesn't like it, or can't take the time to understand it? Most people are pretty busy doing their own work, and they will need to see some benefit to themselves in order to get involved in my work. It appears that I must learn a lot more in order to quantify the benefits of this upwelling scheme, and be able to ask intelligent questions and understand the answers that I get. I also need a better understanding of how it helps corals and other creatures to form their skeletons and shells.

Fortunately, there are books, papers, and information on the Internet. I have purchased many books, the most recent being "Ocean Biogeochemical Dynamics" by Jorge L. Sarmiento and Nicolas Gruber. To read straight through this book is impossible, but I can jump around and dig into topics where I already have some understanding, and work from there. The book was published in 2006, so the authors are collecting corrections and publishing them on a website. They are also helpful in answering specific questions about their book. But I have learned not to scare them by mentioning OTEC-powered pumps that upwell cold water and nutrients.

ECONOMICS

The benefits from surface cooling and increased ocean food production would be dispersed globally, but the job of designing, building, deploying and maintaining the OTEC-powered pumping stations would fall to the richest nations. The task of forging the necessary international agreements would involve international governing bodies like the UN. It is difficult to imagine that this might happen in a human civilization where exploitation and war seem to have higher priority. Deterioration of world conditions will not automatically make us more altruistic and cooperative; the opposite is more likely without extraordinary leadership.

The Virgin Earth Challenge, announced by Richard Branson and Al Gore is an attempt to encourage the development of remedies for global warming, but it is based on an individual enterprise model that is incompatible with the size of the program required to deploy an array of OTEC-powered upwelling pumps. I entered the idea in the contest, but withdrew it after studying the Participation Agreement, which prohibits participants from engaging in discussions with non-Virgin entities regarding "exploitation" of the "Design" for a period of 15 years. How do these lawyers expect progress to be made on a project requiring the contributions of many people and corporate entities with different knowledge and resources? Also the participant must claim to own all "Rights to the Design". In the real world, every contributor to the project retains his/her/its intellectual property, including proprietary know-how and patents. Were the Virgin lawyers anticipating some gadget, like a compact fluorescent bulb, that can be advertised on the Home Shopping Network? Another shortcoming of the Virgin Earth Challenge is that the $25,000,000 prize sounds great, but only $5,000,000 gets distributed initially and it is spread out among an unspecified number of participants. You have to demonstrate successful operation with no bad side effects for 10 years to get the rest. If you tried to split your piece of the prize among all contributors to the project, the rewards would be miniscule compared to each contributor's cost, and many of the contributors won't be around for the final payout.

It can be seen that the question of economic feasibility of the upwelling scheme involves many issues, such as technology, environmental benefit, ocean productivity, motivation, and allocation of resources. I will have to muddle through this by myself until I can convince others to get involved. In the meantime, there are many other problems that we need to work on, such as supplying fresh water to the world population. And dare we ask if there are ways to limit the human population other than by war, genocide, disease, starvation, and environmental disasters?