TECHNOLOGY

Irradiating sludge

The smelly, sticky, gooey residue from wastewater treatment plants, appropriately called sludge, has been piling up in cities all across the country. Plans to recycle sludge or dispose of its contaminants are for the most part unrealized. The JOURNAL OF WATER POLLUTION CONTROL has warned that the United States may be on the verge of a "sludge crisis" unless effective disposal methods come into practice quickly.

Last month, the Deer Island Wastewater Treatment Plant went on line in the Boston area. Its answer to the sludge problem has been to expose the sludge to an electron stream from a 50-kilowatt accelerator able to deliver between 100,000 to 1 million rads to the passing sludge. The radiation is strong enough to kill the viral and bacterial pathogens in the sludge, making the sludge less harmful. And the sludge is *not* made radioactive. At present, though, the irradiator can handle only 380 cubic meters of sludge, a third of the daily production.

Magnetic bubbles come of age

Magnetic bubble technology, invented 10 years ago by Bell Laboratories, has now been put to use in a recorded message machine that informs callers of mistakes in calling. The machine is believed to be the first use of the magnetic bubble chip, a thin film of material (garnet crystal) on which magnetized bubblelike areas have been arranged in sequence.

The arrangement of the magnetized bubbles on the chip determines the type of digital message that can be encoded. The bubbles may be rearranged to form different patterns with an electron beam. The recorded message machine contains four garnet chips with a total memory of 272,000 bits, enough to code for 12 seconds of voice.

Magnetic bubble technology has the advantage of consuming lower levels of power and storing more information in a smaller package than integrated circuits. Bubbles also don't wear out like magnetic tapes and other message machines.

The man responsible for the development of the magnetic bubble memory was honored recently by the Danish Academy of Technical Sciences. Andrew Bobeck won the 1976 Valdemar Poulsen Gold medal for his research in magnetic memories. Bobeck has been investigating magnetic memories at Bell Labs since 1956.

Energy from solar ponds

Low-temperature heat is widely used as an energy source in the United States for such jobs as crop drying, industrial plant heating and food processing. Now Carl Neilsen of Ohio State University has proposed solar ponds to provide this low-temperature heat.

Solar ponds produce low-temperature heat (around 140°F) through the use of salted water. Exposed to sunlight, the salt-laden water near the bottom is heated but is too heavy to circulate to the upper levels where mixing would reduce the temperature. The upper cooler region acts as a transparent insulator to help retain the heat at the bottom. Pipes can then be placed near the bottom to extract the water to be circulated through normal heat exchangers or radiators.

Neilsen's prototype pond was estimated to provide 50,000 kilowatt-hours last year. At a construction cost of $8,000, Neilsen calculated the heat cost only 1.8 cents per kilowatt-hour. However, some problems still need to be worked out. Algal growth on the surface of the pond and convection from wave action caused by winds effectively reduced the temperature of the hot bottom water. Nevertheless, Neilsen feels that solar ponds could provide 10 percent of U.S. energy use.

PHYSICAL SCIENCES

And now charmed molecules

The world of charmed particles that physicists have recently discovered becomes curiouser and curiouser, or perhaps Alice the physicist would say "complicateder and complicateder." The latest suggestion is the existence of charmed "molecules" by A. De Rújula, Howard Georgi and S. L. Glashow of Harvard University.

In the Feb. 14 PHYSICAL REVIEW LETTERS, these theorists point out that so far experiment has found four charmed mesons. Two of these represent the ground or lowest-energy states of an electrically neutral and a positively charged particle, designated D^0 and D^+. The other two are the first energetically excited states of these, called D^{0*} and D^{+*}. Each of the D's supposedly consists of a quark and an antiquark.

The D's are usually produced in pairs, each D with its appropriate anti-D. The majority of this production takes place in the annihilation of colliding electron and positron beams with an energy about 4.028 billion electron-volts. The theoretically curious thing about it is that the pair production is heavily dominated by the D^{0*} and the anti-D^{0*}.

This suggests to the theorists that an intermediate state in the production is a kind of D-meson resonance or molecule, a four-quark state in which the D and the anti-D maintain their individuality though bound together for a time. Eventually they come apart. Analysis of the implications of the idea suggests to De Rújula, Georgi and Glashow that a rich spectroscopic hierarchy of such charmed-meson "molecules" may exist.

The faint young sun and the warm earth

There is a seeming paradox between the temperature history of the sun as deduced from the theories of the nuclear-fusion processes by which it generates its energy, and the temperature history of the earth as deduced by paleontological records. The problem was outlined at the recent meeting of the American Physical Society in Chicago by Michael J. Newman of Caltech and Robert T. Rood of the University of Virginia.

A billion years or more ago the sun should have been fainter and cooler than it is now. The usual theory of the thermonuclear reactions in stars have them starting with the lightest nuclei, hydrogen, and gradually converting them to helium and on to heavier nuclei. As the nuclei in a star get heavier, the star should get brighter and hotter.

The difference between a billion years ago and now in the sun's energy output is only 5 percent, but that is more than enough to suggest that a billion years ago the earth should have been solidly frozen in an ice crust. From what we know of earth temperatures at the time, the earth wasn't frozen. In fact it may have been slightly warmer than it is now. Newman and Rood mention the suggestion that the earth's atmosphere then may have been different enough to produce a greenhouse effect, but point out that there is no evidence for the greenhouse. "The discrepancy . . . indicates that there is a serious problem with our understanding of the structure of the sun, or of our understanding of the earth's climate or both," they conclude.

The galaxy's biggest bubble

Evidence has been found in the past to suggest that supernova explosions blow bubbles or cavities in the interstellar gas that pervades the galaxy. In a recent announcement by the National Science Foundation a group of astronomers from the University of Wisconsin at Madison, led by Ronald J. Reynolds, reports the biggest such bubble yet. It is the Gum nebula. It is about 800 light-years across and is expanding at 144,000 kilometers per second.