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Advances Being Made in Cold Climate Solid Waste Remediation
(by Charles Mac Arthur)

The management of solid waste in extreme climates (i.e., polar or desert regions) presents challenges that require innovative solutions. Even small villages generate a considerable volume of solid waste. The composition of waste in many cold regions is somewhat different than waste in similar-size towns in either temperate or tropical regions, in part because of the special packaging required for long shipments to rigorous climates. In addition, traditional methods of disposal which work in more moderate climates don't necessarily transfer to harsh climates where biodegradation rates are greatly reduced and rubbish cannot be properly buried or treated. Other problems related to developing landfills in Alaska and similar climates include: limited land availability due to steep slopes and competing uses; scare organic soils which do not support heavy equipment and provide little fill for covering refuse; high water tables; and, potential impacts on wildlife habitat and aesthetics in relatively pristine areas.

At the same time, energy costs are high in remote communities, particularly where fuel is shipped great distances by barge and stored during long winters. Because of the high costs of energy and land filling, small-scale waste-to-energy systems that are easy to operate would appear to be promising alternative technologies for rural communities.

Low Energy Technologies of Sangverille, Maine in the U.S. has been working for several years on waste disposal/utilization issues and technologies, with a particular focus on specialized technology systems for small, isolated communities. Similarly, the Alaska Department of Community and Regional Affairs has been involved in a parallel effort for slightly larger communities. IETC feels these experiences may have application in many developing and in-transition countries.

Quinhagak, Alaska is a small, remote Eskimo village on the shore of the Bering Sea with a population approaching 550 people. Its landfill is a simple fenced enclosure on the tundra. As the entire region sits atop nearly 70m of permafrost, burying or covering rubbish is impossible. Approximately 5m3 of rubbish is produced each day, some 2,000m3 annually. The landfill is normally ignited during an on-shore wind, producing heavy brown smoke and leaving a pile of unsightly and unevenly burned waste.

In March 1996 a Tribal Waste Energy Recovery Plant (TWERP), which recovers heat from a modular solid waste burning device, was installed on a

Major Projects

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IETC's Tools

ESTIS

- ESTIS facilitates creation and management of websites on the Internet, sharing and searching of information across multiple ESTIS websites, publishing of information by non-web designers and decentralized management of content.

PAMOLARE

- PAMOLARE is an environmental modelling tool to forecast the changes in water quality leading to the eutrophication of Lakes and Reservoirs.
The versatility of PAMOLARE allows for its use in decision making process as well as for training purposes.

pilot basis in the village. This simple technology did, however, require cultural adaptations: for the first time villagers were required to pre-sort rubbish at home into "wet," "dry" and "anything that clinks" categories. This requirement may seem straightforward enough, particularly in a small village, but compliance required a community education effort and endorsement from the Tribal Council. Even with the "obvious" advantages the system would bring overtime (heat recovery, fuel savings, waste volume reduction, jobs, profits from recycling nonburnable wastes, etc.), Eskimos are no different than most peoples in that changes which are new and perceived to be less convenient are slow to be embraced. It should also be emphasized that while the TWERP will "solve" a part of the solid waste management issue, it is best viewed as a component of an integrated system offering small, isolated communities the chance to better manage an increasingly complex problem in ways that provide direct benefits to the community.

The TWERP is a small 275 kg burning unit that can be transported in a pickup truck. Since Quinhagak has no road connection to the outside world, however, the unit was delivered by air (6,500km from the point of manufacture in Maine - northeast U.S.). The total cost was US$4,300, including US$1,200 for shipping. Villagers were instructed to separate rubbish, and burnables (approximately 60% of the total rubbish generated in Quinhagak) are sent to the TWERP. Non-burnables are treated in a variety of ways discussed below.

The results to date in Quinhagak are mixed. Once proper feed rates and fuel composition are determined, the unit should burn waste and produce useful heat energy, without smoke, smell or noise. The TWERP does not require accelerator fuels to assist in the heat conversion process, relying on the rubbish itself as the sole source of energy. The heat energy produced is being stored in the form of hot water that is used on demand to heat the Tribal office building and post office by means of heat exchangers. However, the TWERP will not consume glass or other non-burnables. A small electrically powered hammer mill is proposed to pulverize salvage glass. This hammer mill reduces glass to a fine, high quality sand (approximately 20:1 ratio of loosely packed glass to the sand end-product) in about 10 minutes. The salt-free sand has many uses, including as an additive for cement, a cleaning abrasive, or as a paint mix for non-skid surfaces. Approximately 10 kg of burnable rubbish in Quinhagak is currently producing the equivalent of 4 liter of fuel.

Aluminum cans are currently being crushed and bailed for eventual resale (1996 market value in Alaska about US$1000 per 450 kg), and cardboard and newspaper have many uses, particularly when shredded and mixed with wet garbage, such as composting for use as a soil building additive and as a weed control mechanism.

Previous studies have also shown the TWERP system effective in reducing medical wastes; these mixed with other combustibles (including disposable diapers that have become a major problem worldwide) can contribute to energy production and are reduced to a sterile residue ash of about 1% the original volume. If problems related to the acceptance of this simple technology can be overcome at the village level, it may be possible for larger communities to install an improved unit capable of consuming greater amounts of waste.

A parallel, but separate, effort to test the viability of a slightly larger-scale processing system has also been initiated in Copper Center, Alaska, a community producing approximately 320,000 kg of rubbish annually. The cost of a five-year project cycle is US$647,900, and includes contributions from four sources: the Alaska Science and Technology Foundation - $175,000 cash; Entech Inc. (regional bioenergy programme funds) - $257,900 cash and in-kind; the Copper River Native Association - $180,000 cash and in-kind; and, Ahtna Inc. - $35,000 in-kind.

The technology being employed in this case is similar to the TWERP in terms of engineering and operation. The Thermal Oxidation System (TOS), a modular solid waste burning device, will be operated on a batch basis of approximately 900 kg, per day for a 10-hour run cycle. Heat will be recovered in the form of hot water and used in nearby buildings, resulting in savings of between 27,000-32,000 liter of fuel oil annually. Ash will be collected manually, regularly tested for toxicity, and stored in a traditional landfill site until a determination can be made whether it has other practical and economic uses. Due to the low combustion temperature of the TOS, aluminum, steel, and glass will remain intact. These nonburnables can therefore be separated after burning, although the long-term goal is that they be separated before disposal for recycling. The Alaska Department of Environmental conservation has indicated that no air quality permit will be required, given the facility's small size and low emissions; however, Entech Inc., the lead company for this project, has indicated that it will monitor ambient air quality impacts on nearby residential areas and voluntarily perform a risk assessment according to USEPA guidelines.

Any INSIGHT readers interested in Solid Waste Management (SWM) technologies for small and remote areas, particularly those with harsh climatic conditions are encouraged to contact Mr. Charles Mac Arthur, Development of Low Energy Technologies, POB 355, Sangverille, Maine 04479, or <agate.net/~tralchem>. It should be stressed that the TWERP technology may be freely copied and adapted outside of the U.S. and its territories. Information on the TOS can be obtained from Mr. Peter Crimp, Alaska Department of Community and Regional Affairs, Division of Energy, 333 W. 4th Ave., Anchorage Alaska 99501 USA, tel: +1-907-269-4631.

The Author About Himself:

"I am Charles Mac Arthur, an obscure Maine inventor whose special area of interest is low energy technologies and working with Yup'ik Eskimos on the shores of the Bering Sea. ... The rate of inventiveness seems to accelerate in direct proportion to my 68 year's proliferation of my gray hairs and wrinkles. ... I have more than 60 examples, for better or worse, of ways to find petroleum independence and kick oil addiction, proved to my satisfaction and waiting on the shelves to be taken down when the PetroPause happens. The post-petroleum world better come soon, I am not getting younger! It would be just my damned luck to kick off the day before the big adventure commences!"

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