Summary

Water and Sanitation Products using Lifesource Technology

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Status Report on Lifesource Technology

by

UNDP/World Bank Water and Sanitation Program

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LIFE SOURCE
TECHNOLOGY FOR THE DEVELOPING WORLD

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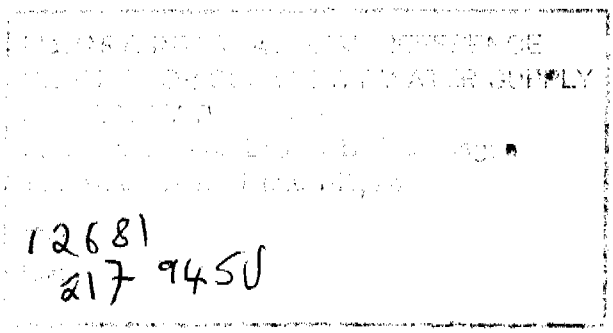


EXECUTIVE SUMMARY

Introduction

After spending approximately $120 billion in the 1980's for water and sanitation systems in developing countries, the goals of safe water and sanitation set by the UN General Assembly for the 1980's -90's, will not be achieved in most developing countries by the year 2000.

> **Currently 1 billion people are still in need of safe water and 1.7 billion people are in need of adequate sanitation in developing countries; the global demand is expected to increase by 600% over the next thirty years, according to the World Bank.**

Existing, traditional and outdated, technologies have not been able to provide coverage for the increasing populations of the developing countries.

In January 1992, Lifesource began a 17 month joint development program with the UNDP/World Bank Water and Sanitation Programme and UNICEF. This resulted in the development of a new low-cost technology for the construction of water and sanitation products using a proprietary Lifesource resin system.

Lifesource mass-manufactured water and sanitation products, utilizing proprietary materials, can provide the projected needs of large scale water and sanitation projects for developing countries through lower overall project costs and speed of construction utilizing indigenous labor.

THE PRODUCTS AND TECHNOLOGY

Lifesource Technology

Lifesource is using, as a basis for the new low cost water and sanitation products, an inflatable mold technology that was originally developed and patented, in 1974, by Jar W. Dorfman for the construction of boats.

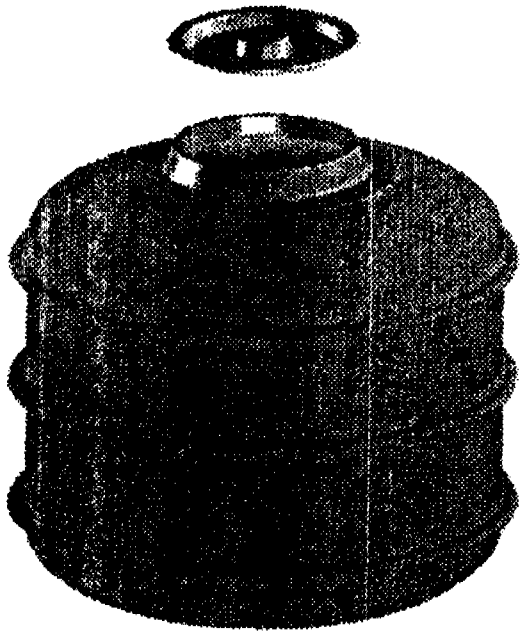
By combining plastic inflatable molds, natural fibers that are grown in many developing countries, and a proprietary water-activated resin, water storage tanks and domestic sanitation systems can be constructed by local community labor.

Product Applications

Drinking Water Storage (Cisterns)

Modular Latrine Components

Safe drinking water storage (Cisterns)



Lifesource water cisterns are constructed from three major components: inflatable vinyl molds, woven natural fiber cloth and water-activated plastic resin. Cisterns are built by applying layers of plastic resin-impregnated natural fiber cloth (jute, sisal or other locally grown and processed fibers) over an inflated vinyl mold. The mold is a large plastic bag in the shape of the cistern and is inflated with an air pump or blower.

After the laminating resin in the natural fiber outer shell has cured, the air is released from the vinyl mold and the product is structurally ready for installation and use. The vinyl mold is now bonded to the outer shell and remains inside the tank as a permanent waterproof hygienic liner.

The inflatable mold natural fiber system provides Lifesource with the ability to increase or decrease cistern capacity without costly design, production, or construction modifications. Size adjustments to the vinyl mold are neither difficult nor expensive to implement.

Environmental Sanitation

There are many types of latrines in use around the world. Examples are the pit latrine, the "VIP" latrine, the pour-flush latrine, and the dry compost latrine. Each one of them can be used relatively safely and reliably depending on soil composition, ground water depth, and surface contours. The principal latrine building material has been concrete. The slow speed of traditional construction techniques, with their need for skilled masons, and the expense of material transport, prevents rapid coverage of the sanitation sector. The Lifesource sanitation system introduces a modular design that allows different components to be added depending on the type of sanitation required. The Lifesource natural fiber, plastic laminate squatting slab is a more viable alternative than concrete and can be adapted for use in any type of latrine.

Lifesource is presently working on a self contained compost latrine that can be installed in existing dwellings as a simple odor-free indoor sanitation system, or as an above ground outdoor facility. In either case human excreta is retained in a sealed anaerobic container, which during use and the subsequent composting process, is never in contact with the

outside environment. By segregating the solid fecal component, there is no possibility of ground water contamination by fecal coliforms or toxic pathogens. Depending on the project requirements, urine can be filtered and dispersed or stored and recycled as natural fertilizer as are the safe composted fecal solids.

SIGNIFICANT PRODUCT ADVANTAGES:

a. Lower Overall Project Cost:

- Economy of scale:
  The speed and simplicity of constructing Lifesource products will provide the possibility for large community building programs and greatly reduced administrative and project management costs.
- New appropriate mass production technology:
  The centralized production line manufacture of the major Lifesource product components provides for low cost bulk container shipping of materials to project destinations.
- Low maintenance:
  Lifesource products are constructed from a combination of traditional and modern materials that provide strength and resistance to environmental degradation.

b. Community Participation - Involvement of Women

> *Experience has shown that the involvement of the community, and by women in particular, is essential for the implementation and sustainability of village level and national water and sanitation projects.* (Global Consultation 1990)

Women and children are essential partners in the planning process and decision making of water and sanitation facilities. Lifesource demonstration projects in El Salvador and Guatemala were built by women and children from the community.

c. Sector Coverage

> *If the provision of safe water and sanitation is to keep pace with global population growth, new solutions and products must replace out dated inappropriate technology.* (Global Consultation 1990)

Lifesource products are easy to construct. They are designed for assembly by unskilled labor, and can be constructed and installed much faster than other products. It takes about 3 weeks to complete a project building 6000 liter

Lifesource water cisterns for 100 families. It would take 26 weeks using existing cement technology.

d. Sustainability

One of the most expensive lessons of the 1980's was the attempt to achieve sector coverage with conventional technologies. Which led to high costs, lower community participation and low sustainability.

In comparison, Lifesource products have an expected life span of 15 to 20 years and except for periodic painting, require minimal maintenance. Participation by the communities in construction of water and sanitation products will heighten user awareness, pride of ownership and thus ensure better long term maintenance of the facilities.

e. Large Scale Replicability

Lifesource products are constructed from materials that are globally available. The volume and weight of Lifesource building materials is approximately 1/10 that of conventional construction materials and permit inexpensive international shipping and in-country transport. This is particularly significant for rural areas where materials must be moved into remote regions on bad roads with inadequate means of transport.

f. Environmental Contributions:

Reduced Energy Expenditure

Due to poor quality, water must be boiled in many rural and peri-urban areas. The use of scarce trees for fuel-wood is a major problem in developing countries. The use of trees for fuel wood also has a devastating impact on agriculture and the ecology. Stripped of its vegetation cover, the land erodes through wind and seasonal rains and as fuel-wood becomes more scarce, farmers burn animal dung and crop remains instead of returning these nutrients to the soil.

Supplementing Ground Water Depletion:

In Africa, almost 60% of all potable water that is consumed comes from underground sources. Over pumping in many areas has resulted in a major lowering of the water table with a reduction of ground water available, degradation of soil and the increase of pollution.

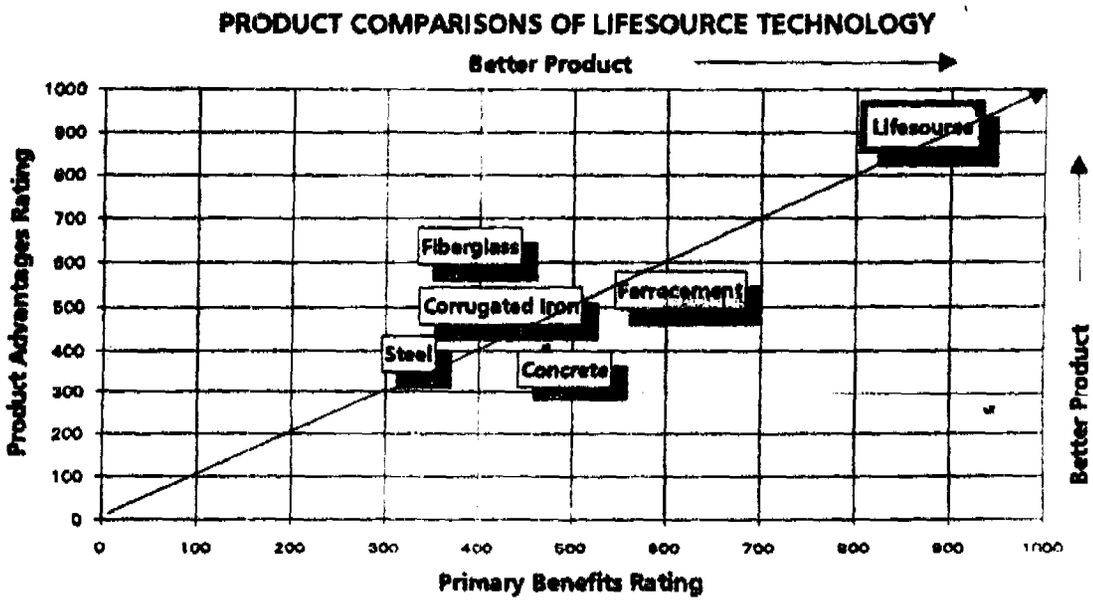
Underground water sources often become contaminated due to inadequate rural and peri-urban sanitation facilities through the leaching of human waste. Lifesource has designed sanitation systems that prevent fecal contamination

from human waste. Such systems are necessary wherever soil conditions are conducive to water contamination.

PRODUCT COMPARISON

Most of the water and sanitation products, that have been installed by governments and agencies, have been manufactured in small quantities, by small, local companies using conventional heavy weight and costlier technologies.

The most effective way to evaluate Lifesource products is by comparison to other existing products and technologies. The following chart evaluates other products by comparing their primary benefits and product advantages. Values are calculated based on the importance rating of each benefit or advantage.



STATUS REPORT OF THE TECHNOLOGY

The following three pages provide a UNDP-World Bank Water and Sanitation Program summary of the Lifesource Technology.

UNDP-World Bank Water and Sanitation Program

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Natural Fiber Reinforced Laminate Construction - A New Technology for Water and Sanitation Products

The United Nations Development Program (UNDP) and the United Nations Children's Fund (UNICEF) are both committed to the development and application of low-cost and sustainable technologies for the provision of water and sanitation services to low-income communities in the developing world.

In 1991, these agencies entered into an agreement with Lifesource International Inc. to jointly develop a new technology that promised to provide an inexpensive and user-friendly method of producing water and sanitation products. The system of natural fiber reinforced laminates is based on the following components:

- a cold-curing, water soluble resin that can be locally manufactured, readily distributed in small quantities, is easy to use, and presents no health or safety hazards;
- natural fibers to provide reinforcement to the resin. The project focussed on jute because of its wide availability, but a number of other natural fibers could be substituted;
- an inflatable vinyl mold where appropriate. The mold also acts as an inner waterproof liner for products such as water tanks.

Product development

The project was carried out over a 17 month period during which numerous resin systems were evaluated in the USA, Central America and the Netherlands. The optimum system was found to be a commercially available powdered urea formaldehyde resin which, when modified by addition of about 10% of a newly developed liquid copolymer, provides excellent material properties.

Development of the jute fabric included determination of the optimum weave and pre-treatment of the fibers to provide resistance to rotting and improve "wettability" by the resin. Being an organic material, the fiber is the component material most susceptible to deterioration. However its low cost and availability throughout the world make it the fiber of choice.

It was found that the vinyl molds should be manufactured from supported (reinforced) fabric to ensure dimensional stability during the fabrication process, and should be painted with a bonding agent to ensure adhesion to the resin when it was required that the mold become a permanent inner liner.

Testing at the TNO laboratories in the Netherlands substantiated that the material combination produced thin walled laminates that possessed both good structural properties and good life expectancy. As an additional protection against ultraviolet degradation, exposed products are painted with an acrylic paint.

Demonstration Projects

Two demonstration projects were carried out in Guatemala and San Salvador with the following objectives:

- to demonstrate the suitability of the technology for fabrication of water cisterns and latrines;
- to demonstrate that laminated products can be produced easily and rapidly by unskilled participants from local communities with a minimum of training;
- to optimise product specifications and fabrication processes.

Water cisterns were constructed in Guatelmala and latrines in San Salvador. In both cases women and even children enthusiastically participated, clearly demonstrating the ease with which products could be produced by local enterprise.

Costs

One of the main reasons that the UN agencies entered into the joint R&D project was that the new technology promised to lower the cost of water and sanitation services. Cost savings appear likely to accrue as a result of several advantages of the laminate fabrication system:

- the process is rapid, so many products can be produced in a short time;
- the process is simple, so highly skilled labor will not be essential;
- because of thin wall construction, the quantity of materials used is small;
- inflatable molds save on the cost of temporary formwork (eg for water tanks).
- both raw materials and fabricated products are easily transported.

The cost of products will vary considerably depending primarily on the quantity required and the local availability of component materials. For example, in Central America where the demonstration projects were carried out, both Indian and local jute is available at low cost. Supported vinyl can also be manufactured in Central America. Food-grade vinyl is necessary for tanks storing potable water, requiring a minimum purchase of 5,000 yards. However, it is most cost-effectively purchased in container-size quantities - about 6 times as much and sufficient to fabricate approximately 2,780 cisterns of 3,000 liters capacity. Di-electric heat sealing equipment is not currently available in Central America but would become so for a sustained annual (regional) demand of a few thousand units. Alternatively, it may prove more economical

to manufacture vinyl molds in bulk in one country because of economies of scale, low production cost in some newly industrialised countries, and the low cost of shipping and storing the fabricated molds. Other components are readily available, either locally or imported in small quantities until demand grows to a point justifying local manufacture.

A survey carried out in 1990 indicated a range of approximately $53 to $115 per cubic meter in the cost of water storage tanks. The laminate technology is competetive with those costs for small quantities (a few thousand per year) and significantly cheaper for large quantities, particularly when the cost of transportation, and product breakages, *after* manufacturing is taken into account. The use of the technology for manufacture of latrines also shows potentially substantial savings on current costs of approximately $450 for constructing a composting latrine which seems to be the regional preference. However latrines come in many types and further development work is needed to determine the best application of the technology to those different types.

Future Prospects

Prior to disseminating details of the laminate technology, it is necessary that it be subjected to a substantial field application requiring several thousand water tanks and latrines. This will enable fine tuning of the manufacturing procedures, demonstration of products under field conditions, determination of quality control parameters, and development of applications of the technology to other products. Anyone interested in participating in such a project with Lifesource International is invited to contact one of the following representatives of the agencies that participated in the initial produc. development phase.

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