WATER RESOURCES

Growing shortages - and some Middle East solutions

Many countries are just waking up to the fact that they have water problems. But Kuwait already supplies almost its entire needs from desalination, while Saudi Arabia is considering an even more novel solution — using icebergs.

"Here we are, conquering space, visiting planets and still two-thirds of the population – mainly women and children – have to walk miles to find water and then carry it back to their homes on their heads," says Yahya Abdel-Majid, former Sudanese minister of Irrigation & Hydro-electric Power and secretary-general of the UN Water Conference held in Mar del Plata, Argentina from 14-25 March. "And many of these people can watch men walking on the moon on their village television sets."

Practically speaking, we cannot live without water. Drinking water is our most apparent need, although 80 per cent of current water consumption is for agriculture. We need water to grow food, for washing and waste disposal, for manufacturing, for generating power, for transport, for fishing and for recreation. Water affects every facet of our lives, but, as Majid says, "water is rarely in the right place at the right time." Even if it is, it is frequently not of the right quality or quantity. Floods and cyclones demonstrate the destructive power of water in the wrong place at the wrong time. Water also erodes, it can be polluted and it carries disease.

Water covers seven-tenths of the earth's surface, imbues the atmosphere and lies in unfathomed seas within the earth's crust. But less than 1 per cent of this vast stock is available for human consumption, the rest being ocean brine or locked away in the polar ice or deep underground. No life is possible without water and the good life demands plenty of it. Industrialised societies guzzle water at staggering rates; agriculture, faced with 4,000 million mouths to feed, grows ever more thirsty. And as the world's poor – most of whom have no supply of clean drinking water – move towards prosperity, the need for water goes steeply up.

Everywhere, the result of greater water use has been greater water pollution. Rivers become toxic sewers, some of them inflammable from the chemical wastes they carry. Great lakes, fed with the foamy effluvia of cities, die slowly. River fish and even seals in the arctic collect a variety of chemicals in their tissues, the residual poison of industries that are sometimes thousands of miles away.

Considering the tremendous importance of water, it seems incredible that more has not been done to solve the world's water problems. In seeking to remedy that, the UN conference followed previous gatherings which dealt with issues all related to water. During the past few years, the international community and the UN have been concerned about the environment – this led to the Stockholm Conference on the Human Environment. They have been concerned about the impact of increased population and this initiated the World Population Conference in Bucharest. They have been concerned about the food shortage, and there was the World Food Conference in Rome. They have been concerned about the status of women, and there was the Mexico City Conference. The UN Conference on Human Settlements was the latest.

The fact that water is related to all these issues is perhaps one of the reasons that the water conference took place. Widespread drought in some areas and flooding in others have certainly made the international public more aware of water problems. These are some of the grim realities:

– Reasonably safe supplies of drinking water are unavailable for at least a fifth of the world's city dwellers and three-quarters of its rural people. In many countries, less than half the urban population and less than a tenth of the rural population have an adequate and safe water supply.

– Increasing and unplanned concentration of population and industry in large urban areas strains water supplies. This leads to waste disposal problems which, in turn, degrade the quality of life and environmental health.

– Proliferation of industrial processes, greater use of energy and increased agricultural activity are causing progressive and chronic degradation of the quality of available water by the increase of toxic compounds and other pollutants. The effect of these substances poses a potential threat to human life.

– Backwardness and relative isolation of rural areas, where the great majority of the world's population now lives, make it more difficult to provide adequate and safe supplies of drinking water, improved sanitation and waste disposal.

– Expansion of food production in water-short areas and in marginal lands has made rapid development of irrigation and land reclamation necessary, to the degree that water and land resources have often been exploited to their limits.

– Ever-growing land degradation from such causes as waterlogging, salinisation and erosion is leading to losses in production potential, investment and employment.

– Ground water supplies are being exhausted, while both surface and ground water sources are deteriorating in many places.

– Water use is often needlessly inefficient and wasteful.

– Expensive technology for water development to compensate for shortage is straining inadequate financial resources in many regions.

– Conflict about rights and priorities among users intensifies as the demand for available water accelerates.

Unlike the supplies of other natural resources, the total global supply of water is fixed. It can be neither increased (as with timber or fish) nor diminished (as with petroleum or coal). Since water is continuously being renewed through the natural hydrological cycle, it is potentially inexhaustible. While this is so, locally available supplies can at the same time be quickly depleted or made unusable by inadequate conservation, pollution or overall careless management.

Wise management of the world's water was the key goal of the UN Water Conference. There must be such management on an international, regional and national scale, according to conference organisers, if a global water crisis by the end of the century is to be avoided. In order to reach this goal, the conference concentrated on laying the groundwork for international co-operation and on helping governments to frame national and regional water policies. The urgent need of developing countries to train personnel, to carry out research and to assess their water resources was stressed. Without assistance in these fields, it will be impossible for developing nations to meet their development needs in the next two decades.

One of the most interesting features of the conference was the exchange of national experiences. Over 200 papers circulated from over 50 countries covered a wide range of topics: "deterioration of water quality due to long-range transport of air pollution" (Norway and Sweden), "the use of remote sensors in hydrology" (Argentina), "water rights and land control in arid areas" (Botswana), "the world's water in a human perspective" (Holy See), "international co-operation in the conservation of international water courses" (Yugoslavia) and "water for domestic use in rural areas" (Thailand) are examples. Some papers dealt with specific national problems and sometimes innovative solutions – for example: "increase of the Nile yield – the Jonglei Canal project," "adjusting time of seeding for exploiting yield potential of high-yield rice in irrigated areas in Bangladesh," "comprehensive utilisation of the water resources of the Volga," "the role of desalting technology in meeting Kuwait's fresh water needs," "the importance of the Zaire river basin in the area of Central Africa" and "the counter-measures for mercury and PCB in Japan."

Various "non-conventional" methods of solving water problems, such as towing icebergs to desert lands, seeding clouds to make rain, suppressing evaporation and desalination, were mentioned in many conference documents, but, for most countries, they are unrealistic in terms of today's widespread problems. "They are still expensive," says Majid "and we have got water under foot and in front of us that we have not used. We must find ways to use this water first. Only 3-4 per cent of the water in Africa has been tapped. Only 6 per cent in Latin America. Ninety-seven or 98 per cent of the water in all of Africa, Asia and Latin America has not yet been explored."

Of the several "non-conventional" water technologies, desalination is perhaps closest to becoming conventional. Since the 19th century, ships and some power plants have desalted water through an evaporation process. So far, at least one country, Kuwait, has satisfied almost all its water needs by desalting sea water. With its large oil reserves, Kuwait can afford the tremendous amounts of energy that most desalination processes require.

Annual surface water potential
(million cubic metres a year)

Bahrain	negligible
Iraq	80,000
Jordan	850
Kuwait	negligible
Lebanon	3,800
Oman	10
Qatar	negligible
Saudi Arabia	2,200
Syria	32,000
UAE	160-270
Yemen (Aden)	1,500
Yemen (Sanaa)	n.a.

Source:
UN Economic Commission for Western Asia

After experimenting with various processes, Kuwait's three operating plants have found multi-stage flash (MSF) evaporation the best for its purposes. MSF is the most widely accepted large-scale sea water desalination process and there are MSF plants in many parts of the world. In addition to Kuwait, where a fourth plant is under construction, plants have recently been built in Hong Kong and Sardinia.

MSF consists of heating a large stream of sea water in stages as it flows inside copper alloy tubes. In the last stage, this brine is heated by steam supplied from an external source, such as a boiler or the exhaust from a power plant (many MSF plants are part of dual-purpose power plants). The brine is then admitted into pressurised flash chambers in which, as pressure is reduced from stage to stage, a small proportion of the brine is evaporated. The vapours then condense on the outside of the copper alloy tubes and the condensate becomes the desalted water stream.

Multi-effect distillation (MED), similar to MSF, is the second most popular desalination process. Various countries, including France, Israel and the UK are conducting research aimed at reducing the cost of MED. Among new concepts being tested are various tube designs, the use of low-cost aluminium and low-temperature steam.

Both these processes require sizable equipment and a lot of fuel. Temperatures must be carefully regulated. Within a short time, the metal tubes employed in MSF and MED tend to become corroded. An MSF plant in Florida was recently closed because of serious corrosion difficulties and high energy costs.

In the vapour compression process, a mechanical compressor powered by electricity or a diesel motor forms the vapour which then condenses into desalted water. Although this process has been in use since the early 1900s, its reliability still needs more thorough testing. It is also expensive. With any one of these three processes – MSF, MED or vapour compression – if energy were $ 80 a ton, a cubic metre of desalted water would cost $ 1.

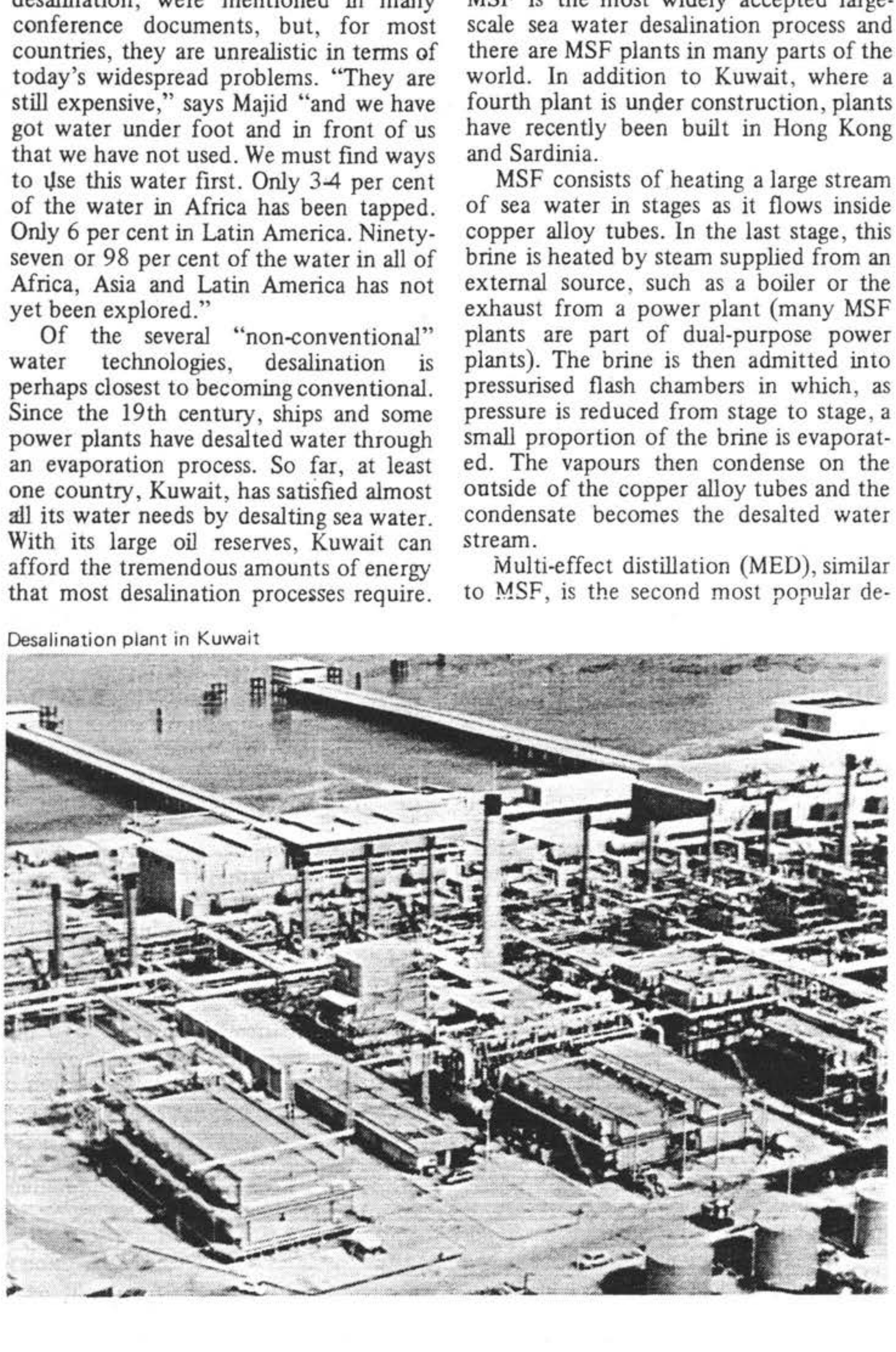
But water desalted by the simplest desalination process – solar distillation – costs even more: $ 5 a cubic metre. This method, sometimes used in remote areas, involves feeding salt water into a pool covered with plastic or glass and waiting while solar radiation evaporates part of the brine. This condenses on the inner side of the cover as the heat from the sun is removed by the surrounding air. Like MSF, MED and vapour compression, solar distillation can be used to desalt sea water.

For brackish water which is not too saline, filtering with electrodialysis is possible. With more saline water, there is reverse osmosis where treated brackish water is compressed and passes under high pressure through a semi-permeable plastic membrane, which rejects 90-95 per cent of the salts. This process is considered the most promising one for the future because of its extremely low energy requirements and its simplicity. Full-scale field testing with various feed waters is now in progress. Hundreds of plants have been built in the last five years. Its present cost is around $ 0.44 a cubic metre. Membranes are a problem, however. They are short-lived, water passes through them slowly and they have a poor salt rejection ratio. Leading membrane manufacturers are attempting to correct these defects.

Perhaps the most novel suggestion for overcoming water shortages is to import icebergs from the arctic or antarctic. There have been persistent reports that Saudi Arabia's Saline Water Conversion Corporation has "highly advanced blueprint plans" to use giant tugs to tow icebergs from Antarctica.

The icebergs would be moored offshore and chopped into blocks, which

Desalination plant in Kuwait



would be moved to an oil-fuelled melting plant. The water would then be piped to the towns and cities. It is estimated that the cost of melting, storing and piping water from icebergs would be a tenth that of desalinating sea water. One UK oceanographer, Louis Marrow, says: "The Saudis have a perfectly workable scheme for using between five and seven tugs to tow a mile-long iceberg of between 90-130 million tons for an unlimited distance." The underwater mass of the iceberg, he said, would be sprayed with a mixture of plastic and resin to lend stability as it is moved. Some scientists suggest that such an operation could cost $35-50 million.

A British scientist working in Saudi Arabia said: "The work done out here proves that desalination is virtually obsolete. The icebergs are pure water and they are there in abundance." One particular iceberg, 45 miles long and 25 miles wide, has been drifting slowly into the South Atlantic since breaking away from the antarctic ice mass nine years ago. Nicknamed the "ice palace," it is being closely watched by scientists using satellite photographs and is thought to contain enough water to supply Greater London for 2,500 years. Apart from this, the largest iceberg ever recorded, there are about 1,000 "marketable" icebergs in circulation each year, if the technology could be found for making use of them to supply water for a thirsty world. MEED

OMAN

When desalination alone is not the whole answer

Sean Milmo

Oman's desalination plant has been operating for 18 months now. But the new five-year plan (1976-80) sets out to exploit a more traditional source of water: the 2,000-year-old underground irrigation system.

Foreign surveyors carrying out preliminary studies of Oman's water resources around two years ago came up with some unexpected results. Four consultancy firms – two British, one Dutch and one French – concluded tentatively that the country had enough ground water to double the total area under cultivation, estimated to be around 36,000 hectares. In the Sharqiya area of the Hajar mountains in the north, it was estimated that cultivable land could be expanded by as much as three times. But the consultants advised that none of these objectives could be achieved without expert management and strict conservation.

The Omani government and its advisers, however, were not impressed, even though the surveyors' findings seemed to destroy the idea that Oman was a country with seriously depleted water resources. They believed that the consultants' programme was expensive, complicated and fraught with uncertainty. At the same time, the country needed water supplies urgently for the growing capital area of Muscat, Muttrah and Ruwi, and it might have taken too long to bring into operation a scheme for tapping ground water.

Instead the government decided to build a power station and desalination plant at Al-Ghubra on the outskirts of the capital area, which would meet both its immediate water needs and the demand for electricity. The water survey teams were told to stop work and were sent home, even though they had not completed their final reports. The European head of the National Water Resources Centre, set up by the Food & Agriculture Organisation (FAO) to supervise the surveyors and draw up a water conservation and management programme, was also removed.

"We were completely amazed when we were told to stop our surveys, particularly because we thought we were doing such good work," said a hydrologist on one of the survey teams. "Our studies showed that the country's agriculture had much more potential than was originally thought. Theoretically, at least, Oman could be the future California of the Arabian peninsula."

The Omanis, however, like the governments of many other developing countries, are faced with a dilemma which is outside the experience of the foreign consultants. This is whether to opt for a technology, like desalination, which becomes operational without much delay or administrative difficulty, or for a long-term and intricate programme which might require mobilisation of manpower on a large scale and complex organisational machinery.

The decision to build the desalination plant was not taken without some dissension within the government. The government's own Centre for Economic Planning & Development, which was co-ordinating development plans, supported the need for water surveys and a water conservation programme. But its views were opposed by ministers, led by the Minister of Communications Abdel-Hafez Salim Rajab, who was responsible for the capital area's water supplies. His opinion prevailed and, in March 1974, he was able to gain approval for construction of the desalination plant from Sultan Qabous, who had not been directly involved in the arguments.

Since then there might have been regrets about some aspects of the decision.

Pipeline project in an Omani town