

will come together to conduct research activities. We hope that this institute will be well utilized and that there will be effective service to support a recycling society for the twenty-first century. For the same purpose, we hope to receive contributions from Asian researchers. We would like to provide this research institute as a kind of forum in which Asian people, in particular, can educate themselves. In November 2000, we are scheduled to hold an international conference on final disposition here in the City of Fukuoka. Now, at the conclusion of my presentation, I would like to invite today's participants to come to this international conference scheduled for the year 2000. I truly wish for further information and human exchange among Asian-Pacific cities. This concludes my presentation.

**Presentation** |||||

**Mr. Zhang Yi**

**Deputy Director, Chief Engineer**

**Institute for Design and Research in Environmental Engineering, Shanghai**

#### **Chairman**

Thank you, Professor Hanashima, for your presentation. Professor Hanashima's keynote speech focused on the status of waste in various industrialized nations, the current situation regarding waste management in Japan, waste processing methods suitable to Asian climate, and landfill construction, particularly comparing aerobic and anaerobic structures and their merits. I'm sure we all hope for the early realization of a recycling society as discussed. We also hope the international conference on final waste disposal in the year 2000 will be a great success.



Next we will have a case study presentation from Shanghai City.

#### **Mr. Zhang Yi (SHANGHAI)**

Thank you very much for inviting Shanghai to participate in this Asian-Pacific City Summit Second Working Level Conference. I would like to talk about the present status and future planning regarding household waste disposal in the City of Shanghai. The City of Shanghai presently presides over fifteen administrative districts and five prefectures. It has an area of 6,340 square kilometers, of which inland districts occupy 6,121.8 square kilometers and its wooded district 121.85 square kilometers. The population, as of 1996, was 14,191,000. Of this figure, 9.5 million is the city area population and 3.5 million a migrating population. The GDP (gross domestic product) growth of Shanghai in 1996 was 287.776 billion yuan. And, having set

a per capita of 22,086 yuan, it is presently China's greatest economic center. According to our plan, which has an ultimate goal of developing the city into a modern international metropolis, Shanghai, by the year 2010, will have achieved the status of an economic, financial, and commercial world center. In order to realize this continuous growth, the city must see development which is socially, economically, and environmentally harmonious.

I would like to outline the status of household waste disposal in the City of Shanghai. The volume of Shanghai's daily discharge of household waste in recent years shows an increase between 1990 to 1996, exceeding 6%. We believe this household waste will continue to increase. It is projected that the increase rate will be more than 70%. Now, let me touch upon the composition or content of Shanghai City's waste. A clear difference is visible in the breakdown of household waste content in Shanghai City's districts by what type of fuel the residents use. Shanghai's gas usage rate is 88% of residents. For these gas using districts, the ratio of leftover food and vegetable rubbish has decreased and the rubber and plastic portion has increased. Other items have shown little change.

Regarding low calorific value of garbage, there is a gap when comparing Shanghai to advanced nations. However, the current projection for low calorific value of household waste in Shanghai indicates a large growth. Shanghai has already fulfilled certain requirements for household waste disposal by incineration. Household waste collection in the urban area of Shanghai is seen to by the city's Environmental Management Bureau and the districts' Environmental Management Bureaus. The collection of household waste is divided into two stages: from the collection point to the transfer wharf, and from the transfer wharf to the landfill site or dump site. The district does the first stage and the city does the second stage. The transfer wharves are mainly spread out along the Suzhou He River and the Huangpu Jian River. At this time, the disposal of household waste in Shanghai is mainly based on the sanitary landfill method. Garbage dumps are a secondary method. In the early 1980s, a compost factory was constructed and an aerobic decomposition system employed. However, because the cost of operation escalated, the factory was closed down in 1995.

The city has three main household waste disposal facilities. The Sanlintang Dump was made in the 1950s. This site has a maximum dumping height of thirty meters and an estimated disposal capacity of 500 tons per day. The Jiangzhen Landfill was constructed in 1985 and has a disposal capacity of 800 tons per day. Laogang Landfill was constructed in 1988. Its first phase construction has a disposal capacity of 1,500 tons per day. By the second phase construction in 1993, the capacity reached 2,500 tons per day and the facility has since fulfilled the conditions necessary for

becoming sanitary land. After the third phase construction is completed, the capacity will be 3,750 tons per day.

Looking at this situation, there are still problems. We need to improve problem areas in the process of our development. Currently, we focus only on the landfill method and dump site method. We haven't yet progressed in turning waste into resources or decreasing household waste volume. On account of Shanghai's development in city planning, usable land is increasingly diminishing. Yet a large amount of land is necessary for household waste landfills. This will go against the conditions necessary for continued growth of the city.

In the past several years the discharge volume of household waste in Shanghai has increased at an accelerated pace, placing a large burden on existing disposal facilities. The operation rate of each of Shanghai's disposal sites is exceeding the expected disposal capacity by a large margin, giving rise to overloads in operation. Shanghai is a super metropolis and its source of household waste is distributed over a large area and its volume is considerable. Presently, household waste from the Puxi District is taken into Laogan Landfill in Pudong for disposal. However, the round trip is 130 kilometers, adding transportation expense and creating the potential of polluting areas along the railway line. According to the Suzhou River's Comprehensive Anti-pollution Plan, transfer stations along its river banks which are used as household waste transport wharves, will gradually be closed down, thereby forcing the city to radically reconsider its distributional placement of environmental sanitation facilities and methods for household waste transport.

Methods for household waste transport which primarily use the sea remain weak against natural calamities. In the event of fog, typhoons, heavy rains, hardship in sea travel, or insufficient access to the bridge pier at times of high water level, same day disposal of the city's entire volume of household waste can not be guaranteed. On account of Shanghai's general plan and also as a result of the construction of Pudong International Airport, the Jiangzhen Landfill and the Sanlintang Dump will inevitably have to be moved or go through some adjustment. This will then place additional hardship on the already pressed household waste disposal situation in Shanghai.

Shanghai's existing household waste disposal methods, as well as its facilities, will not be able to meet the city's demand from growth, as you can see.

By shifting from the current single landfill system to the adoption and continued use of plural technologies, 30% of the city's total household waste will be incinerated by the year 2000, employing a method combining concentration and decomposition. We will implement this method as follows:

- 1) Construct incineration power plants in Puxi and Pudong, each with a disposal

capacity of 1,000 tons per day.

- 2) Construct small to medium incineration sites, with disposal capacity of 350 tons per day or 200 tons per day, in each area.
- 3) Construct a sanitary landfill in Pudong to dispose 500 tons per day of household waste. Construct a 300 ton per day landfill in Puxi to dispose incinerated household waste ash.
- 4) Construct a rough household waste disposal site with a disposal capacity of 250 tons per day.

By the year 2010, non-polluting household waste disposal will be effected. The rate of incinerated disposal will be increased to over 80%, by shifting to incineration as the primary and landfill as the secondary method of disposal. Major plans are as follows :

- 1) Construct five large scale and seven small to middle scale incineration sites.
- 2) Construct a large sized landfill to dispose incinerated household waste ash.
- 3) Construct nine transfer stations for household waste compression and shift the collection system from sea transportation to inland transportation.
- 4) Build resource recycle factories to recycle household waste.

When the above project is completed, a rationally distributed, efficient, household waste disposal system for the city of Shanghai will have been implemented, taking full advantage of advanced technology. Such a system will make possible the harmonious development of the city's social, environmental, and economic sectors, which will promote each other, together on a path of improvement.

This concludes my presentation. Thank you very much.

## Discussion

**Chairman**

Thank you very much, Mr. Zhang Yi of Shanghai. Domestic refuse management in Shanghai is going through a process of change due to urbanization. You have pointed out that the current capacity is not enough. I hope that you will achieve the appropriate level of equipment and disposal by the year 2010, so that citizens can enjoy a good quality of life. As the presentation is complete, we will now have questions and comments. Any questions, please.

**Mr. Tetsujiro Hara (KITAKYUSHU)**

I am from Kitakyushu city. I have a question. In regard to the transportation of waste in Shanghai, now you are trying to change from sea transportation to inland transportation. In the case of Kitakyushu, for your information, we have

coastal landfills, and sea based as well as land based transportation are two methods we can utilize. As far as we are concerned, due to traffic conditions in the city of Kitakyushu, we emphasize ocean based transportation instead of land based transportation. Looking at actual performance last year, ocean transportation accounted for more than 80 %. It is true that hard vehicles contribute to pollution. We are trying to improve conditions in this regard. Also in Shanghai, I understand you have a plan for further landfills. I would like to ask you to expand on your thoughts about ocean based transportation. Could you emphasize it to reduce traffic in the city?

**Mr. Zhang Yi (SHANGHAI)**

Thank you. Let me respond to your question. It seems Shanghai is quite similar to the situation in Kitakyushu. Our coastal transportation also accounted for 80 %. There are three major issues we are faced with now. Point one concerns the landfills of Shanghai. All of them are located along the seaside. There is a distance of sixty-five kilometers from the city, or round trip one hundred thirty kilometers. So the haulage distance is long. Point two: Shanghai has two major rivers, the Suzhou and Huangpu Jian river. There is serious pollution of those rivers systems. Local city government officials would like to do something about this. To be more specific, waste taken to the seaside should not be transported by sea. We have existing landfills and we would like to continuously utilize those landfills. But in addition, we would like to build large incinerators and expand the landfills. And we would like to be rid of the water pollution problems in the Suzhou. Land based and sea based transportation will be used in combination but we would like to put more emphasis on land based transportation.

**Prof. Masataka Hanashima (FUKUOKA UNIVERSITY)**

You said by the year 2010, in China, there are going to be five large scale incineration plants and seven small incineration plants established. In Japan, it would take about ten years from the planning stage to construct incineration plants. I would like to ask how you communicate with the citizens and residents. Also, incineration costs a lot and requires many expenditures. You are actually working on construction in parallel, for there are a number of installations. It seems very difficult in economic terms. I should like to ask for your comments on that point.

**Mr. Zhang Yi (SHANGHAI)**

Thank you very much. In Shanghai, we have already been preparing for several decades — more than decades. Of course we don't have sufficient funds. However,

for the Pudong area we have had discussions with France about the construction of the incineration plant. For the west part of the Huangpu Jian River we are talking with Spanish companies. We would like to attract foreign investment. Already we have received approval. In the year 2000, we should be able to start and we will be able to introduce foreign capital and investment. In Shanghai City this situation is progressing. I think the Shanghai situation is quite similar to Japan. We have a shortage of land, we have a lot of waste and also the population is large. Under the current plan, we will of course use the existing landfills, but we would like to shift gradually to incineration plants. Of course, the fund raising issue is the most crucial issue. In concert with seeing to other issues, we are now raising funds. Initially we invited investment from foreign companies and now we are thinking of a loan. Also, we'd like to invite Japanese or other overseas environmentally related manufacturers to come to China and cooperate in the construction of incineration plants.

As for the citizens, they are quite cooperative in their attitude. We have done surveys on the site selection for the incineration plant construction. The citizens gave us their support. With this construction, Shanghai's environment will be upgraded dramatically.

**Prof. Masataka Matsufuji (FUKUOKA UNIVERSITY)**

I am Matsufuji from Fukuoka University. In the future you would like to implement an intermediate processing method. Speaking from Japanese experience, it is very important to recycle and reuse waste. I would like to ask what your plans are for the recycling of the waste.

**Mr. Zhang Yi (SHANGHAI)**

In Shanghai City, working with the environmental bureau officials, we are now putting emphasis on the reuse and recovery of waste to resources. We have three approaches. One, we would like to move from the decentralized type of waste management we have now to a more centralized type. And two, we'd like to shift to a combination of incineration and landfill methods. Three, we'd like to emphasize turning waste into resources. Of course, we'd like to utilize methane gas and also the micro-organic method. Additionally we'd like to implement composting. By the year 2010, we'd like to achieve these goals and we are incorporating this plan into specific plans.

**Mr. Teruo Hongo (FUKUOKA)**

You seem to be emphasizing intermediate processing, particularly in terms of incineration in Shanghai. The composition of garbage is quite important to this. Food leftovers

account for about 60 % of waste, according to your presentation. In the case of Fukuoka about twenty years ago, the calorific value was 1,000 calories per kilogram. That was twenty years ago, but now it has gone up to 2,000 calories. There was no change in the collection processes. Twenty years ago, in terms of composition of waste, we had food leftovers accounting for only 25-30 %. The water content at that point in time was about 55-60 %.. There was a high water content in that type of waste. The water content has come down to 30-35 % nowadays and we have a lot of paper. From the data you provided, in the year 2010 the calorific value is projected to be 1,600 kilocalories. The energy is increasing. Maybe you could expand on how this data was collected. Why have you come up with an estimated 1,600 calories in terms of the calorific energy, please?

**Mr. Zhang Yi (SHANGHAI)**

The City of Shanghai has waste with a calorific energy which is similar to the energy you used to have some time ago. We estimate it at 1,100 kilocalories, in the current situation. This estimate is based upon the fact that we collect separated types of waste. In twelve areas in Shanghai we have already started the separation of waste refuse, and by the end of the century Shanghai will apply the separation method in all areas. One category is combustibles and the second category is noncombustibles destined for landfills, by this I mean bulk refuse. If this plan is implemented as scheduled, the combustible refuse of the City of Shanghai will likely produce a higher calorific value than current estimates. There are three features. We have water content as high as 60 % in Shanghai refuse. And the energy level is relatively low. And thirdly, due partly to the consumption pattern, we have a lot of variation on a monthly basis. So with all these factors, we will have difficulty in terms of collecting the refuse and in terms of increasing the energy. Technology selection is vital, particularly in regard to materials with low energy value. Again, for waste in Shanghai, we believe that we can incinerate, but incineration is expensive. We plan to attain power generation from waste management, but the calorific value is problematic.

**Mr. Roger Matthews (AUCKLAND)**

In order to control windblown rubbish, odors, birds and rats at landfill sites, clean material is often used for daily or weekly cover. In such a big landfill as you have in Shanghai, there is often a need for large volumes of clean soil and clay material to cover the refuse. This is often a management problem to obtain this material. Have you been able to solve this in Shanghai?

**Mr. Zhang Yi (SHANGHAI)**

The landfill site is located near where the Chang Jiang River flows into the East Sea. The river brings sufficient sludge to be used as as cover material. But the cover material will become insufficient for the future. Therefore, we are now trying to use red soil. We have seven landfills right now and in those where there is not enough cover soil we dig up soil in the peripheral areas and bring that to use as cover. At this moment, we are satisfied with the amount of cover material.

**Prof. Masataka Hanashima (FUKUOKA UNIVERSITY)**

I am a specialist and researcher in waste management. There are very few people focused on waste management research and this is problematic. I am sure there are a lot of universities in Shanghai. Is there research and investigation in Shanghai universities on waste management? Or is there any kind of research institute inside the city for waste management?

**Mr. Zhang Yi (SHANGHAI)**

In China waste management, and especially research into waste management, has just begun. There are very few researchers and scholars doing research on waste management. In Shanghai and other cities, there are not many university departments which focus on it. But there are now a few more than ten well-known departments that research waste management. They are actually providing and training experts and researchers to work on waste management. We have an institute comprised of 100 staff. And we are researching waste collection, waste management, and disposal. This research is one of the ways we are exerting efforts for Shanghai waste disposal. Although there is a research institute in Shanghai City this is not the case throughout China. There is a variance in the scale of such research institutes.

**Presentation** ||||||||||||||||||

**Mr. Park Nam Bae**

**Staff of Landfill Management, Pusan**

**Chairman**

We would like to move on to the next case study presentation.  
The next speaker is from Pusan.

**Mr. Park Nam Bae (PUSAN)**

Good morning, ladies and gentlemen. I am Park Nam Bae from Pusan. In Pusan we use landfilling and I would like to share

