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Wastes MANAGEMENT

The monthly IWM journal for
the Professional Waste Manager



International Issue

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- Recycling
- Waste Minimisation
- Packaging Waste
- Containers & Weighing Equipment

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Nominations for IWM Junior Vice-President

Nominations for the next Junior Vice-President of the Institute of Wastes Management will soon be required to be submitted to the Chief Executive Officer. It is normal for the Junior Vice-President to become the Senior Vice-President in the following year, and then to be elected as President for the year after that. Thus, the Junior Vice-President for 2000-2001 will

become President of the Institute for 2002-2003. If not already a General Councillor, on election as Junior Vice-President, the person concerned automatically becomes a member of the General Council, ex-officio, and remains so throughout their period of office and for a further year after their term of office as President.

Candidates for the Junior Vice-

Presidency must be Fellows of the Institute, and nominations should be received by the Chief Executive at Institute Headquarters by the 31st December 1999. Nominations must be in writing, and must be proposed and seconded by any two General Councillors or Centre Councillors. A standard nomination form can be obtained from Mark Gibson at IWM headquarters on tel: 01604 620426.

Professionalism is not just a question of image but one of responsibility

In recent weeks we have seen two devastating tragedies - both caused by earthquakes. The first of these was in Istanbul and this was closely followed by similar scenes in Taiwan. If these two tragic events have taught us anything, it is that the highest professional standards must always be adhered to in the protection of public health.

Industries such as civil engineering, construction or, for that matter, the waste management industry, are never under such close scrutiny as when a disaster such as these earthquakes occur, particularly when it leads to widespread loss of human life. Natural disasters they may be, but this will not stop the public and the media looking to lay the blame

IWM COMMENT by Tony Hiron

closer to home.

In both cities hit recently by earthquakes, it was all too easy to quickly establish that standards, especially in the construction and design of buildings, played a significant part in the terrible loss of life.

A key role of a professional Institute such as ours is to ensure the highest standards of operation, to promote best practice, and to protect life, health and the environment. Similarly, it is incumbent

on members of such a professional body to understand and undertake their own individual professional responsibilities. If standards and regulations are flouted, then blame is rightly apportioned.

There is a third role which is just as vital, and that is the role of regulator. If standards are in place, then they need to be monitored, inspected and the results reported to ensure that they are being adhered to.

The appalling death count, particularly in Taiwan, was due in no small part to the likely flouting of building regulations - we all need to ensure that our commitment to high standards ensures that our actions do not cause or add to further disasters in the future.

IWM HQ IWM Business Services Ltd.

ADDRESS: 9 Saxon Court
St Peter's Gardens
Northampton NN1 1SX

STAFF:

Editor: Patricia Jennings
Tel: (01604) 620426
Email: pat.jennings@iwm.co.uk
Sub-Editor: Clare Jukes

Sales Executive:

Sally Selwood & Lee Coyle
Tel: (01604) 620426
Fax: (01604) 604467

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Municipal solid waste in Kazakhstan: urban waste management problems in a transition economy

Management of municipal solid waste in the Central Asian Republics combines issues common to growing cities anywhere in the world with features special to the former Soviet Union. The countries of the region typically have a relatively high level of technology and education, but decaying infrastructures and a history of poor practice in waste management.

Current economic problems mean there is a lack of money for new investment by municipalities, although this is partly offset by the new involvement of the private sector, and the increasingly important role being played by non-governmental organisations and the public. Almaty, the former capital of Kazakhstan, is an example of a city tackling some familiar problems in ways that take advantage of experience from the rest of the world.

Kazakhstan is one of the newly independent republics of the former Soviet Union. Situated between Russia and China, with an area of 2.724 900 km², the republic is approximately the size of France, Germany, Spain, Sweden, Finland, Italy and Great Britain put together but has a relatively small population of 14.95 million. It has an extreme continental climate, with temperatures ranging from as low as -45 °C in winter to +45 °C in summer. Kazakhstan is rich in natural resources but like most of the former Soviet Union it is currently going through the transition to a market economy. The country has an educated population and reasonably good infrastructure: legacies of the Soviet period, however, include a tradition of strong regulation but weak enforcement of environmental protection measures, and lack of an integrated approach to waste and environmental management.

At present, rapid political and economic changes are affecting everything, including patterns of production and consumption, source and size of municipal budgets, private sector activity and public acceptability of waste management practices. As a result of these factors, major cities in the region face some challenging problems in the management of municipal solid waste (MSW). This paper aims to provide a background to the situation and present a typical example from the city of Almaty.

Situation in Kazakhstan

Reducing the volume of waste generation from production and consumption, and prevention of environmental pollution by waste, are serious social and environmental problems in Kazakhstan. At present, an estimated 14 million m³ or 3.4 million tonnes of MSW are generated annually in the cities and regional centres. The average amount of waste generated, depending on lifestyle and climate conditions in the cities of the republic, is 220-280kg per person annually. A further 30-

by Tatyana B Vermenicheva,
Lyazzat M Saribekova, &
Sonia Heaven

50% is added by public organisations (schools, canteen, shops, hotels etc). It is anticipated that the volume of MSW will increase one-and-a-half times in the next 10-12 years.

Most of the waste stream (an estimated 97%) is deposited at illegal dump sites which have an adverse impact on the environment. Dump sites occupy 1350 ha of city and regional centres. Every year sizeable areas are added to dump sites, often including valuable agriculture land, and the state of these sites is unsatisfactory. For example, 92% of sites have no surface or ground water protection systems, and dumping and buffer zones are absent at 43% of sites. Analysis of site operations demonstrates that the methods used for storage of MSW are outdated and are reaching their limits. Firstly, storage and neutralisation of wastes is labour intensive. Secondly, further vast areas are required and high costs are incurred for transportation of waste to landfills that are often located far from city boundaries.

Regulatory aspects

Finding solutions to the problems surrounding MSW is currently hindered by the absence of a well-developed system of legally enforceable regulation of waste handling operations. Kazakhstan's environmental legislation, both newly implemented and dating back to the Soviet period, contains a number of acts and norms regulating different aspects of storage, transportation, recycling and disposal of waste. Regulations are implemented and

enforced by different departments of local and national government, and no single organisation has a co-ordinating function. Such important aspects as the monitoring and inventory of wastes and the licensing of waste handling activities are not regulated by legislation.

The main legislation governing environmental protection is the Environmental Protection Act of the Republic of Kazakhstan 1997. Article 60 is entitled 'Environmental requirements for handling of production and consumption waste'. In practice, this article simply makes provision for detailed regulations to be made by other bodies.

A draft law on the use and recycling of production and consumption waste was scheduled by a resolution of the Kazakhstan Government on 15 December 1995. A working group tasked with the preparation of the draft law was created by the Ministry of Environmental Protection and Natural Resources (formerly the Ministry of Ecology and Bioresources). The working group made use of world practice and general principles of legislation from the USA, Czechoslovakia and Russia, materials from UNO meetings, and, in particular, decisions of the Basle Convention.

The draft law is based on legal norms in the Constitution and on the general principles of environmental safety in the Republic of Kazakhstan as outlined in the Environmental Protection Act 1997. The main purposes of the draft law are to unify unco-ordinated legal norms regulating the activities of state, legal and natural entities in the sphere of production and consumption waste, to systematise public management of waste-related activities, and to define economic methods which will stimulate reductions in the volume of wastes. This draft has not yet become law.

Table 1: Composition of MSW by weight according to different sources

| Components of MSW | Reference 7 (%) | Reference 3 (%) |
|-------------------|-----------------|-----------------|
| Paper | 22.9 | Up to 40 |
| Food waste | 33.6 | 24-40 |
| Yard waste | 21.2 | - |
| Textiles | 7.3 | 4-5 |
| Glass | 2.7 | 4 |
| Metals | 1.5 | 2-5 |
| Plastic | 1.6 | 1-2 |
| Leather, rubber | 1.4 | - |
| Wood waste | 3.3 | 3 |
| Other waste | 4.6 | - |

| | |
|----------|--|
| 3 | INDUSTRIAL AND DOMESTIC WASTES |
| 3.0 | To develop a project for improvement of the system of collection, recycling and storage of solid household waste in Almaty |
| 3.1 | To finish and approve 'Rules for the treatment of solid household and industrial waste', providing for: <ul style="list-style-type: none"> • Rules for treatment of packaging and containers which remain after use of the commodity; • Classification of waste intended for processing and disposal; • Conditions for separate collection and delivery of waste for recycling; • Conditions of a unified system for the calculation of formation and disposal of waste; |
| 3.2 | To determine specific norms for formation and accumulation of production and consumption wastes for legal and physical entities |
| 3.3 | Step-by-step introduction of a system for separate collection of glass waste |
| 3.4 | To make an assessment of abandoned and ownerless accumulations of waste in the city |
| 3.5 | To organise processing of waste through a system of small and medium businesses: <ul style="list-style-type: none"> • Waste-papers and cardboard; • Glass waste; • Plastic; • Unwanted mercury-containing; • Rubber technology; - Including chemically dangerous materials. |
| 3.6 | To create local waste transfer station with presorting and compaction of solid household waste (pilot project in Turksib region) |
| 3.7 | To carry out renovation of the waste processing plant with technology for sorting and high compaction of solid household waste - To organise production of packing containers from waste paper in the territory of the waste processing plant |
| 3.8 | To develop a project and provide facilities in part of the city's waste polygon for disposal of toxic industrial waste. |
| 3.9 | To conduct an inventory of mercury-containing equipment, substances and other highly toxic waste |
| 3.10 | Organisation of facilities for processing mercury-containing devices |
| 3.11 | To establish weighing facilities on the city's waste polygon |
| 3.12 | Development of optimum plan for restoration of the waste transfer station |
| 3.13 | Restoration of the city's waste transfer station |

Table 2: Section 3 of the draft plan for environmental improvement of Almaty 1999-2001

MSW generation in Almaty

Almaty is the former capital city of Kazakhstan with a population of 1.12 million. It is situated in the south-eastern part of the country at the foot of the Zailiyskiy Ala-Tau mountain system. The city has two main types of housing - five or nine storey blocks of flats, and single-storey individual houses.

Like all big cities, Almaty has become a large generator of MSW. The term MSW includes the following types of waste in Almaty: waste generated in private houses including flats; maintenance waste and ash from district local heating systems; green waste and fallen leaves collected from parks; large household goods; and refuse collected on the streets. It is estimated that approximately 2 million m³ or 500,000 tonnes of solid waste are generated annually in Almaty. Data collection is inadequate due to limited resources, and the rapidly changing economic conditions mean that figures go out of date quickly, but according to one survey the volume generated in 1996 was 1.838 million m³ or 1.56 m³ per person. Average amounts of solid waste generated range from 250-500kg per person depending on lifestyle, with a further 35-40% from public organisations. The greatest quantity of waste (68%) is generated in regions with multi-storey buildings where the majority of the population lives.

Various sources give figures for the composition of waste, but it is not always stated how these were obtained (eg. by analysis, use of previously existing state norms, or simply using data from elsewhere). Information from two sources is given in Table 1. The first column shows data from a survey carried out in Almaty in 1995, based on generalisation of data from waste collection enterprises. According to this, the moisture content of the waste was 47.2% and the density 253 kg/m³. The data in the second column is quoted as averaged for Kazakhstan but no information is given on its source or the methods used to obtain it. Once again, these figures are likely to be strongly affected by the changing economic conditions.

Waste collection and temporary waste storage

The system used for temporary storage and collection of wastes depends on the compactness of buildings, number of storeys, type and quality of collecting vehicles, and methods of waste transportation.

MSW in Almaty is collected in containers, which are usually sited at communal waste collection points in public areas near blocks of flats, or in the yards of private houses. In large blocks of flats, special chutes are constructed in order to facilitate refuse collection. However, in recent years these have not been

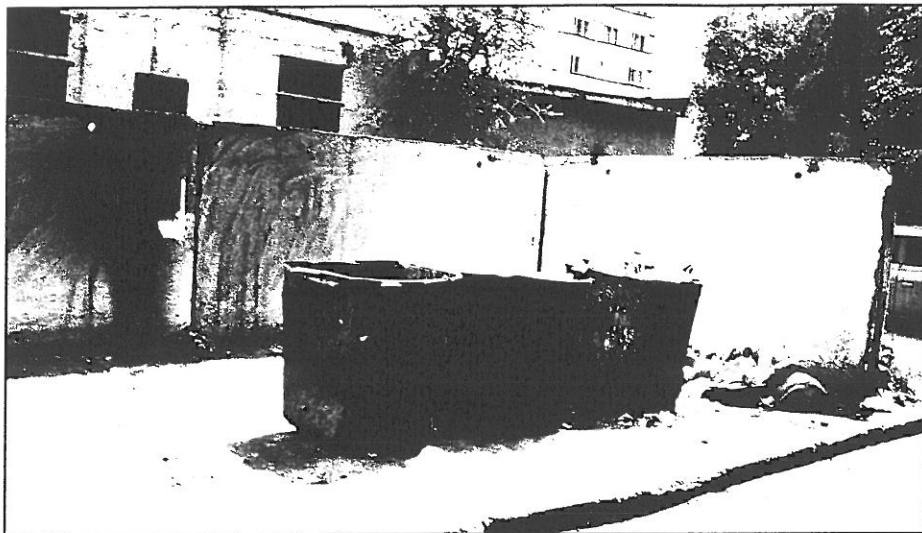
used due to disruption and breakdowns in the system of transporting refuse away from the collection points. Waste from one-storey buildings is collected by the inhabitants in their own containers and is put out along the side of road on specific days of week where it is collected by a truck.

The containers used in Almaty are mainly of 0.55, 0.6, 0.75 and 12m³ capacity. All types of MSW are discarded in the containers: at present there is no system for separate collection of waste, although in the Soviet period there were collections of paper and scrap metal for recycling. The 0.55 and 0.75m³ containers are permanently stationed at the communal waste collection points and are emptied into a collection truck. The 0.6m³ containers are used in buildings with chutes, and 12m³ ones are removed and replaced with an empty container. In practice, however, the number of containers provided is insufficient, with no more than 3-4 to serve several hundred households, and the frequency of emptying is inadequate due to breakdowns and lack of vehicles. As a result, the communal waste collection points are often piled with refuse, and the excess is usually disposed of by burning in situ.

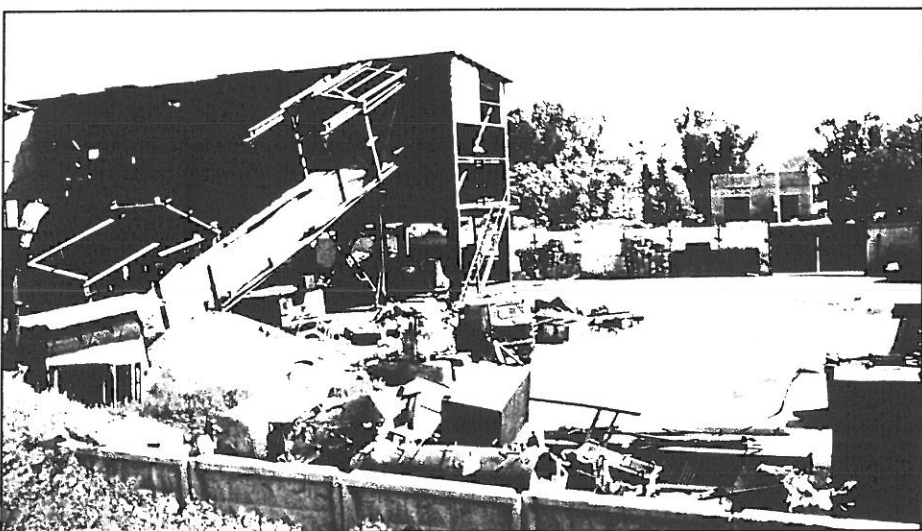
The photograph opposite shows a typical collection point immediately after emptying and cleaning: it can be seen that the bins provided are already full with waste swept up after the departure of the collection vehicle, and any further materials will have to be piled up in the open. Smoke marks from burning can also be seen on the surrounding wall.

Full containers are emptied mechanically into the loading hopper of a vehicle. The refuse is compressed by means of a compacting plate or screw device into the loading space of the vehicle. The waste then goes by a one or two stage transportation system to sites for recycling or disposal. The one-stage route goes directly from the communal waste collection points to the municipal landfill site. The two-stage route involves transportation of waste through a transfer station where wastes are loaded from small-capacity vehicles into larger ones to the landfill site. Trucks with a capacity of 15m³ are used for collection and transportation of waste to the transfer station; vehicles of 40m³ capacity transport waste from the transfer station to the municipal landfill site. After collection at the transfer station, wastes are transported to facilities for recycling or disposal. It should be noted, however, that in practice a significant quantity of the waste goes to illegal dump sites.

Until 1992, MSW in Almaty was handled by a special enterprise that collected and processed waste and was part of the State Joint-Stock Company (JSC) Blagoustroistvo. The task was subsequently taken over by JSC Zhilishnocommunalnoe Khozaystvo, which was reorganised in 1997. Private firms have also been set up for MSW collection; at present, 15 different organisations carry out collection and transportation of waste to the transfer station and landfill site by agreement with individual enterprises, including, in some cases, with the newly-formed housing co-operatives which have been created by inhabitants of the previously state-owned apartments. Organisations that do not have an agreement with an appropriate service organisation transport their waste themselves.



Typical communal waste collection site immediately after a collection round



Almaty waste transfer station is in need of renovation

Waste recycling and disposal sites

Until 1965, waste was taken down to a municipal dump site situated on the land of the Prigorodnyi sovkhos or collective farm. The dump site was then transferred, as a result of the allocation of land for construction of a residential area 800m to the north of the site. In 1983, the site was closed, but it has not been restored, however, and no measures have been undertaken to control its influence on the environment. Both sites were typical illegal dump sites where municipal and industrial wastes were stored and burnt.

A MSW processing plant was built at the south boundary of the old dump site in 1982. This is the only example of a MSW processing plant in Kazakhstan, and was designed for composting of MSW and extraction of ferrous metals. Recovery of non-ferrous metals, glass, plastic, textile, wood, stones, rubber, and leather was included in the technological cycle but was never carried out. In fact, only primary processing of waste was carried out at the plant. The plant's MSW processing capacity was about 66,000tpa, with a compost production capacity of 36,000tpa and recovery capacity for ferrous metal scrap of about 1,000 tpa.

At one time, the plant processed up to 20% of the total amount of MSW in Almaty. However, production of compost was not profitable; firstly the quality was low - up to 12% of inert materials were present in the

compost, and heavy metals and toxic substances were found in the inorganic fraction - and secondly, it became uneconomic to transport the waste. Recycling of 1m³ of waste at the processing plant was estimated to cost 205.5 tenge, but direct transportation of 1m³ of waste to the landfill site cost only 23.65 tenge (note: the tenge is the national currency of Kazakhstan which at the time of writing has an exchange rate of approximately 200 to the pound sterling; but like most currencies in the region it has suffered major devaluation). In addition, the processing plant was located near residential areas, in violation of sanitary and environmental standards. The plant continued working, however, despite the complaints of inhabitants of neighbouring areas. A large quantity of unwanted compost was discarded in nearby gullies and may have polluted the groundwater. When subsidies for processing of waste were terminated in 1997, the plant stopped work.

The municipal transfer station was built at the north boundary of the old dump site in 1986. The main purpose of the station is to reduce the cost of waste transportation from temporary storage and collection sites in the city to the landfill. It was constructed simply as a pavement for unloading waste, processing it, separating recyclables and loading the waste into bigger trucks. Because the transfer station was constructed as an intermediate point between city and landfill and was not intended to keep waste for longer than one

day, there are no special structures of the type required for a typical sanitary landfill.

The capacity of the transfer station is 500,000m³ of MSW reloading per year, and it can receive 2,000m³ of waste per day. Periodically, however, the regulations for operation of the transfer station are broken and the volume of incoming waste exceeds the outgoing volume. For example, in April 1998, 2,340m³ of MSW was received every day, but only 1,716m³ was taken out to the landfill site. In practice, it is never possible to make up these shortfalls and backlogs in removal, and the transfer station was, therefore, acting as an unlicensed dump site. The station is sited only 500m from a residential area, and nearby houses suffer from smell and flies. There are no facilities for leachate collection, gas collection or emission control, and the wastes are not covered daily. The width of the buffer zone is from one-third to one-seventh of that required. The transfer station had lifting equipment for loading waste into vehicles, compacting waste and also for processing received wastes, such as shredding and sorting. This equipment worked until about 1990 but is now seriously in need of renovation.

Since 1983, waste has gone to the municipal landfill site located 34km from the city. About 4,685 300 tonnes of solid waste were stored at the landfill in the period from 1987 to 1995. The site lacks facilities and good operating practice, and while the original design included lining materials and compaction of the waste, these plans were not realised. With no liner and no leachate collection system, the site operates in violation of regulations.

The landfill is not divided into cells, and wastes are not compacted or covered with clean soil. The quantity of vehicles and plant operating at the site is insufficient and an auxiliary working area planned for was not constructed. Weighing facilities were not even included in the original design, and there is no monitoring or measurement of incoming waste. Each enterprise disposes of its own waste and in addition to municipal waste, the site also receives industrial and toxic waste. There is no control on the dumping of industrial waste, and epidemiological regulations are not observed. In reality, the landfill is simply a dump site and a potential source of environmental contamination.

The municipal landfill site is the only official waste disposal site but most of the city's waste goes to illegal dump sites. More than 10 illegal dump sites were recorded in Almaty at the beginning of 1999, although periodic purges by the city authorities have reduced the number from previous years. In the first half of 1998 it is estimated that the volume of MSW disposed of at the municipal landfill site and transfer station decreased in comparison with 1997 by 46.5% and 4.7% respectively and in total by 27.2%. Around 47% and 62% of waste in 1997 and 1998 respectively was disposed of at illegal dump sites in the city and a small amount of waste was sent to JSC Vtorma for recycling. Most of the waste that goes to Vtorma is secondary raw material. However, recycling of secondary material at the company has decreased from year to year: by 1996 the volume had reduced by a factor of seven in comparison with 1991. At present, only lamps containing mercury are recycled and neutralised by Synap and Amalgama.

Efforts to resolve MSW problems

The problems of the transfer station, the processing plant and MSW have been considered in a number of documents. The Resolution of the Akim (Mayor) of Almaty No. 375 of 1 September 1992 was concerned with environmental questions in the Dorozhnik and Ainabulak residential areas close to the dump sites. In particular, it dealt with compost quality, opportunities for compost use, its impact on the environment, and restoration of the compost area and transfer station.

The Resolution of the Ministry of Ecology and Biological Resources No.11 of 25 March 1993, 'On the environmental situation of Almaty and measures for its improvement', was concerned with changing the location of the transfer station from a residential area, elimination of the dump site, control of transportation of all MSW to the municipal landfill, and the introduction of a three-phase method of MSW digestion with biogas production.

Finally, the Resolution of the Cabinet of Ministers of the Republic of Kazakhstan No. 11184 of 25 November 1993 on improvement of Almaty's environmental situation and the Resolution of the Akim of Almaty No. 68 of 14 February 1994, 'On measures for improvement of the environmental situation in Almaty', referred particularly to municipal waste and the question of moving the transfer station. However, none of these resolutions were implemented.

In July 1998, after a vigorous campaign by members of the public, deputies and environmental organisations such as Green Salvation, documents concerning the closure of the transfer station and restoration of the territory were prepared. A Resolution of the Akim of Almaty of 17 June 1998 and a Protocol of Resolution of 18 June 1998 provided for the elimination of the dump site and improvement of operation of the transfer station. At present, a small area of the site is used for reception, reloading and transport of MSW, and all the waste received is removed on the same day. Figure 4 shows a picture of the area of the site that is still working. The rest of the dump on the transfer station site area has been cleared up.

Future plans

There are currently many opinions and initiatives to provide solutions to the problem of MSW, but little consensus on which of them is best for Almaty. For example, the construction of an incineration plant has been suggested, but there is considerable opposition to this idea from both specialists and the public because of Almaty's existing atmospheric pollution problems. The city is subject to temperature inversions that trap air emissions; an estimated 170,000 tonnes of harmful substances are emitted per year and air pollution exceeds standards by a factor of 2.5. From a practical viewpoint, in a country with vast reserves of space but relatively limited ones of foreign currency, incineration may not be the favoured option, unless it could provide power and heat to the city's district heating systems.

Environmental groups have also been active in proposing solutions. The Green Salvation group suggests separate collection and recycling of municipal waste by means of mini-reprocessing technologies. At present, the option of constructing one large-capacity

processing plant for the whole of Almaty does not appear feasible. Firstly, it is difficult to find financing for large-scale plants, secondly it is hard to provide such plants with sufficient amounts of raw material, and thirdly, material prices are extremely unstable. These conditions can be more easily met by small-scale plants, however, which could be constructed at industrial enterprises, schools, etc. Green Salvation is currently investigating technology for small-scale MSW recycling.

The Tabigat environmental group also suggests separate collection of MSW. The prominent geologist and environmentalist A. Ratsko recommends waste management for Almaty and the Almaty region based on solid-phase digestion of municipal waste, with the provision of appropriate anti-leachate protection to prevent the spread of toxic substances beyond the boundaries of the landfill site. Wastes are compacted and covered with layers of clay and are degraded by the activity of micro-organisms over a cycle of 20 years. The biogas produced during the degradation process could be used as fuel - an attractive option in a city which suffers from regular interruptions to the gas supply from neighbouring Uzbekistan. In 20 years time, it will then be possible to construct sports stadiums or public parks on the site of the former landfill.

The major state-organised initiative is a study for a solid waste management plan for Almaty currently being carried out in collaboration with the Japanese. At the request of the Government of Kazakhstan, the Japanese Government agreed to support a one-year six-stage study. The Japan International Co-operation Agency, the official agency responsible for carrying out technical co-operation programmes, is undertaking the study in conjunction with local and national government bodies including the Ministry of Natural Resources and Environmental Protection, Almaty City Environment Department, Almaty Akimat (municipal administration), and the City Fund for Environmental Protection.

The purposes of the study are design of a general plan for improvement of solid waste management in Almaty up to 2010; a feasibility study for priority projects chosen from the general plan; and transfer of technology to the Kazakhstan partners during study of planning and investigation of MSW management. The main issues that will be decided in the general plan are the share of responsibility of state and private sectors in the sphere of waste management; prevention of environmental contamination by waste disposal and recycling facilities; and strengthening of the financial basis for waste management.

The study will cover the administrative territory of Almaty and its suburbs where MSW facilities used by the city are situated. The Akimat of Almaty has also produced a plan for environmental improvement of the city, which includes sections on waste management and initiatives for clean technology and encouragement of small businesses in recycling and waste minimisation (see Table 2).

At state level, Kazakhstan's National Environmental Action Plan for Sustainable Development (NEAP) includes a pilot project for improvement of collection, recycling and storage of MSW in the cities of Pavlodar, Shimkent and Almaty. The project executors are the state enterprise Almaty MSW processing plant, firms Amalgama and SmpBap,

and the Almaty City Environmental Management Department. The partner organisations are the city administrations (Akimats) and Sanitary Epidemiological administrations. Plans include making an inventory of MSW dump sites, control and measurement of waste generation, and development of economic incentives to decrease the volume of waste. Systems for separate collection are to be organised and operation of the processing plant is to be resumed. It is also planned to put equipment for neutralisation of hazardous waste into operation.

Conclusions

The situation in Almaty is fairly typical of larger cities in Kazakhstan and the rest of the region, though it does not reflect conditions in smaller, less prosperous cities or in rural areas. At present, the city's waste collection and disposal systems do not meet environmental and sanitary regulations or standards. Most communal waste collection points are in need of reconstruction and new equipment. The fleet of vehicles for collection and transport of MSW is inadequate and the waste transfer and landfill sites lack essential facilities and good operational practices. It is clear that many of these problems, such as improperly designed illegal dump sites, have existed for a long time; the situation was exacerbated, however, by the economic collapse after the break-up of the former Soviet Union.

State and city budgets based on local taxation are still small and are stretched by the rapidly changing situation. There are no courses in waste management, and the situation with regard to training and qualifications resembles that in the West 10-20 years ago, when wastes management was only beginning to emerge as a professional discipline. There is a clear need for a stronger legislative and institutional basis.

At the same time, however, there is no shortage of ideas and new initiatives in the state, in non-governmental organisations and in the private sector. Kazakhstan also has the benefit of looking at recent experience in the West and elsewhere, to identify creative approaches to the funding and management of necessary changes in infrastructure and organisation. The present moment, therefore, represents a unique opportunity for the exchange of ideas to try and build a fully co-ordinated approach to the management of municipal solid waste in a post-Soviet economy.

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The authors

Tatyana B Vermeicheva is a Researcher at Kazakh State Academy of Architecture and Construction. Lyazzat M Saribekova is an Environmental Specialist with Gibb Ltd in Almaty, and Sonia Heaven is British Gas Professor of Environmental Technology at Kazakh State Academy of Architecture and Construction.

A full list of references is available from the Institute.