### 2.2.3 Operation System

#### 1) Discharge

The way residents of any city discharge waste from their homes or businesses is directly related to the effectiveness of the waste collection service provided. The discharge arrangements for the waste should be considered as part of the overall collection and transport system.. The discharge system should consider:

- Separation of recyclable materials from the waste before discharge (source separation)
- Time of discharge
- Frequency of discharge
- Location of discharge points
- Self disposal of the waste
- Discharge regulations

The discharge habits of the residents, based on the public awareness survey are shown in Table 2.2.1.

**Table 2.2.1 Discharge Habits of the Residents**

| District / Discharge habit | Bost. | Almal. | Auez. | Med. | Turk | Zhety. |
|---|---|---|---|---|---|---|
| Major housing type | Block housing | | | Low rise block housing and individual housing | | |
| a) Dwelling Type | | | | | | |
| - Low rise block housing and individual housing | 0% | 14% | 23% | 36% | 49% | 68% |
| - Block housing | 100% | 86% | 77% | 64% | 51% | 32% |
| b) Discharge Habits | | | | | | |
| - Source separation | 32% | 43% | 43% | 29% | 38% | 38% |
| - Discharge location | | | | | | |
| - Collection point | 97% | 86% | 79% | 72% | 30% | 48% |
| - In front of the building | 0% | 1% | 6% | 3% | 13% | 20% |
| - To the collection truck | 0% | 7% | 8% | 9% | 46% | 8% |
| - Discharge time | | | | | | |
| - 08:01 – 10:00 | 11% | 12% | 12% | 13% | 20% | 9% |
| - 18:01 – 20:00 | 18% | 16% | 18% | 20% | 21% | 12% |
| - Irregular | 41% | 40% | 37% | 48% | 38% | 65% |
| - Discharge Frequency | | | | | | |
| - Daily | 53% | 54% | 52% | 54% | 45% | 47% |
| - Once every 3 days | 9% | 9% | 9% | 9% | 4% | 10% |
| - Irregular | 11% | 13% | 10% | 15% | 18% | 15% |
| - Self disposal | 1% | 16% | 16% | 25% | 36% | 53% |
| - Regulations on discharge | 0% | 3% | 5% | 5% | 19% | 9% |

Source: Public Awareness Survey, JICA Study Team, March 1999

Most of the discharge habits show no significant differences by district and dwelling type. Brief explanation of the results are discussed below.

### (1) Source separation

About 40% of the residents (50.5% of respondents of individual detached housing) in the city separate recyclable materials before discharge, mostly food waste (74.2% of those that do separate the recyclables), followed by glass (52.3%) and paper (39.2). Most separated materials, other than food waste is placed at the collection points for collection by scavengers, while some are sold (glass in particular). Food waste is usually fed to domestic and stray animals.

The majority of the households separating recyclables do not store them in their houses for more than one week.

In the case of organizations only 28.9% of respondents separate waste, particularly service organizations such as markets, restaurants and bars, followed by supermarkets, and large department stores. The main items separated include paper, cardboard and food waste (in the case of eateries). On the other hand the low level of separation at governmental organizations and schools is notable. Public employees and children should be encouraged to recycle. Also the low rate in hotels (16%) is surprising considering potentially recyclable materials in the waste discharged from them.

### (2) Discharge location

In block housing areas most of the residents discharge waste to collection points where containers are placed, (as shown in the Table for the residents of Bostandyskii, Almalinskii and Auezovskii).

Low rise blocks/individual housing areas residents either place waste in front of their houses or take the waste to designated open stations (collection stations without containers) or illegal dumping points. In Zhetysuskii where respondents mainly lived in low rise blocks/individual housing, 48% took waste to such stations while 20% put waste in front of their houses. In Turksibskii, on the other hand most of the respondents living in individual housing discharged waste when the collection truck arrived.

In the case of organizations, 42% of respondents discharge waste to containers located at collection points in front of their establishments, primarily serving them. Remaining organizations take waste to collection points serving residential areas.

### (3) Discharge time

Irregular discharge time is common in all six districts, followed by evening discharge. Overall 43.7% of the respondent households have no fixed time for discharge, while 43.6% of those who mentioned a discharge time chose the evening hours after 6:00PM when they have returned home. This means that the waste is left at the collection points overnight as the collection service takes place in daylight hours.

In Zhetysuskii district where most of the respondents live in detached houses and the collection service is irregular the rate of irregular discharge is rather high at 65%,.

In organizations, discharge depends partly on opening or closing hours, with 31.2% of respondents discharging waste between 6 and 10 AM and 19.4% after working hours.

### (4) Discharge frequency

Slightly more than half of the respondents in all six districts discharge waste daily, with no significant differences by type of dwelling. Again irregular discharge frequency is rather high at 10% for respondents in block and multi story housing and 15 to 18% for individual housing.

The situation was similar for the institutions surveyed where about 83.3% of respondents discharge waste, once or twice a day.

### (5) Self disposal

More than 20.4% of the total respondents dispose of waste by themselves. Burning is the most common method (88.3%), followed by burial (7%) and composting (4%).

Amongst residents living in block housing (Bostandyskii) only 1% of respondents dispose of waste by themselves, while on the other hand the majority of individual housing respondents disposed of waste by themselves (66.5% of all detached housing respondents). This may reflect the lack of adequate collection services in such areas. Meanwhile only 3 out of 90 organizations interviewed disposed of waste by themselves.

### (6) Regulations on discharge

The manner of waste discharge should be integrated within the collection and transport operation plan, and the residents were therefore asked if they received any specific regulations. Respondents in block and multi-story housing hardly receive any discharge regulations largely due to the container system enforced in their areas. On the other hand residents of individual houses receive some instructions, especially in Turksibskii, which may explain the system of discharging waste at the time of truck arrival.

## 2) Collection Service

### (1) Regulations/Norms for the Service

In 1997 the regulations/norms prepared by various health organizations were approved by the Ministry of Health's Department of Sanitary Monitoring ("Sanitary Rules #3.01.007.97 – Maintenance of Populated Areas Territories"). Some of the norms stipulated in that document and relevant to this Report are as follows (*comments in italics describe existing conditions*):

(1) Specialized collection and transport equipment shall be used for the collection and transport of the waste and operated by state and private companies.
*(Most equipment is state owned, leased and operated by joint stock companies or LLPs)*

(2) Frequency of waste removal shall be agreed upon between the transportation company and the KSK and approved by the local sanitary service.

(3) Domestic and food waste should be removed between the hours of 7:00 AM and 11:00 PM

(4) In block housing territories specified areas should be made for container platforms with convenient access for trucks. Platforms should be separated from buildings by not less than 20 meters and not more than 100 meters. Platform size should be

calculated to accommodate the required number of containers which should not exceed 5 containers on one platform.
*(Most platforms are surrounded on one or two sides by a wall but in many cases there are more than five containers . Truck access is considered but in most cases access space is limited and truck sizes should not exceed that of 8m³ compactor trucks.)*

(5) Waste should not remain within containers for longer than 3 days in temperatures below 0°C and 1 day for temperatures above that.

(6) Waste containers in block housing should be standard metal containers of 0.75m³, and for individual housing where there is no drainage, wooden or metal tanks may be used. The number of containers should be based on the population served and amount of waste generated by each individual.
*(While containers are made of metal they are mostly 0.64m³ in size and the larger containers are mainly found in the newly developed areas or serving waste chutes. At many points the number of containers is insufficient and overflows of waste occur at many locations. Containers are mostly very old and in poor condition. Containers of any kind are rarely provided in individual housing areas and most residents in these areas discharge waste in their own house containers.)*

(7) In summer metal containers should be washed every ten (10) days.
*(It is reported that washing of containers is rarely done.)*

(8) Recyclable materials, such as textiles, cans, bottles, etc. should not be picked out of containers or trucks.
*(Picking of materials from containers by the street waste pickers is often observed. However many residents of Almaty have a thoughtful habit of separating some recyclable materials from waste and placing them separately at the container platform. Waste separation on the collection trucks was not observed.)*

(9) For buildings of 5 stories or more, waste chutes should be provided.

(10) Responsibilities of KSK's, building managers and communal departments of enterprises are listed as follows;

- Conclude contracts for waste removal
- Instruct residents on sanitary rules
- Install container platforms
- Arrange regular washing and disinfecting of containers and container platforms

(11) Responsibilities of collection companies are described as follows;

- Collect the waste as per the agreed schedules
- Prepare route schedules for each collection truck
- Provide waste collection services to private sector individual housing at least once a week

The norms also contain instructions on the discharge of food waste to feed livestock. Special containers should be allocated for this purpose. No such containers were observed.

While these norms/regulations are important it is necessary that they be reinforced by regulations specifying discharger responsibility, such as time of discharge, source

separation, etc. which were discussed in the previous section and should be determined within the context of the collection plan.

### (2) Collection Points and Containers

#### a. Collection point system and container number

Most of the city's waste is discharged at collection points where containers are placed. The waste collection entities report that they collect waste from 6,007 containers located on 1,543 platforms in the city. The total volume of these containers exceeds the daily volume of waste generated by 1.1 (assuming 950 t/day of waste and average 0.7m$^3$ container capacity). However the container capacity allows for only one day of waste storage and as collection frequencies fall below that in many parts of the city, overflow of waste at the container platform is common. Also container conditions are very poor and many cannot be used to their design capacities, or at all.

Districts where individual detached housing is common are usually served by open collection stations where there are no containers; 70% of survey respondents in Turksibskii and 54% in Zhetysuskii take waste to such open stations.

#### b. Walking distances to collection points

The Public Awareness Survey revealed that 75% of the households discharge waste to collection points where containers are provided. Waste collection points are conveniently located close to their residence, with 76% of households reporting that they walk less than 100 meters to their nearest point (57% walk less than 50 meters). About 85% of residents of detached housing reported walking less than 50 meters to collection points. However for most of these residents the collection point is in front of their houses.

In the case of organizations, walking distances are less since many use their own collection points in front of their establishments. Over 74% of organizations indicated walking distances less than 50 meters to collection points.

#### c. Problems at the collection points

Many problems can be observed at the collection points. These are summarized in the following table, which also includes the opinions of the residents.

**Table 2.2.2 Problems at the Collection Points**

| Problem | Reasons | Residents complaining (%) |
|---|---|---|
| 1) Waste uncollected at the collection point | • Problem of collection frequency | 26.2% |
| 2) Waste overflowing at the collection point | • Insufficient number of containers<br>• Lack of discharge regulations (waste discharged after truck has departed) | 13.2% |

The poor condition of the containers is an important factor in the unsanitary conditions at many of the collection points. Many are punctured and leakage of waste leachate is observed. The type of collection system makes it difficult to provide covers for the containers and this creates problems with odors and insect infestation.

Approximately 2/3rds of the public awareness survey respondents answered that the KSK is responsible for cleaning the collection points, especially around the containers. However 16.5% stated that they do that work themselves. These latter respondents mostly live in individual housing.

### (3) Collection Frequencies and Times

In interviews with some of the collection entities they reported that they collect the waste daily from block and multi story housing areas and once or twice weekly from individual housing. It is interesting to compare this with the findings of the public awareness survey.

Only 25% of residents in block and multi story housing responded that waste was collected daily from their areas. On the other hand the majority of residents of detached individual housing (about 60%) stated that waste is collected once a week. The first answer contradicts the statements of the collection companies while the second answer is more in line with those statements.

22% of respondents in individual detached housing and 14% of respondents of block and multi story housing replied that waste collection was irregular. These high figures indicate problems in the collection service.

Finally it is interesting to note the percentage of respondents answering "don't know" to the question about the frequency of service; 35% for block and multi story housing and 10% for individual detached housing. The lower rate of the latter indicates the sharper awareness of these residents to observe the collection times and discharge waste accordingly.

## 3) Waste Collection and Transport

### (1) Equipment and Manpower

#### a. Collection trucks

As reported earlier the number of collection trucks operated by the 34 waste collection entities was 264 units in 1998. Total waste transported by these trucks in that year was reported to be 1.38 million $m^3$ (1.38 million $m^3$ x 0.3t/ $m^3$ = avg. 1,100 t/d).

The collection companies were interviewed about the number of trucks they operate by truck type. Of the reported 34 waste collection entities, 30 companies provided information, as shown in the following Table 2.2.3.

All the trucks are Russian made. Chassis are either Kamaz, Gaz or Zil makes. All the side loader truck trucks are equipped with side loading devices.

Most trucks are old and maintenance problems are frequent. Over 50% of the trucks are more than 5 years old and 20% are more than 10 years old. Based on the interviews with some of the collection entities and results of the returned questionnaires, about 90% of the collection trucks have an operation rate of 60%.

**Table 2.2.3 Truck Fleet Data**

| Model | Design Capacity | <5 yr. | 6-10 yr. | >10 yr. | Total |
|---|---|---|---|---|---|
| A) SIDE LOADER TRUCK TYPE | | | | | |
| 1. KO 413 | 5.5 - 6m³ | 38 | 10 | 13 | 61 |
| 2. KO 415 | 22.5 m³ (9.4 t) | 5 | 0 | 3 | 8 |
| 3. KO 424 | 7.5 - 10m³ (3.1 - 4.3 t) | 16 | 4 | 0 | 20 |
| 4. KO 431 | 7.5 m³ (4.7 t) | 17 | 0 | 0 | 17 |
| Sub-total A) | | 76 | 14 | 16 | 106 |
| B) DUMP TRUCKS | | | | | |
| 6. GAZ truck | 4 – 6 m³ | 6 | 15 | 10 | 31 |
| 7. Zil truck | 4 – 6 m³ | 9 | 31 | 16 | 56 |
| Sub-total B) | | 15 | 46 | 26 | 87 |
| Total A) and B) | | 91 | 60 | 42 | 193 |
| Share of age group (%) | | 47% | 31% | 22% | |

**b. Transfer Trucks**

In addition to the KO 415 compactors listed above, semi trailers (tractor and container combination) are also used to transport waste from the compost plant (operated as a transfer station) and old transfer station to Karasai disposal site.

The following Table 2.2.4 shows the number of transfer trucks available.

**Table 2.2.4 Transfer Trucks Fleet**

| Truck type | Number | Year of purchase | Design capacity |
|---|---|---|---|
| 1) KO 415 | 1 | 1994 | 22.5 m³ |
| | 2 | 1996 | Same |
| | 1 | 1997 | Same |
| 2) bM2 Containers (semi-trailer combination) | 5 | 1985 | 22 – 28 m³ |
| | 4 | 1987 | Same |
| 3) Kamaz 5410 Cabin | 1 | 1987 | |
| | 3 | 1988 | |
| | 5 | 1993 | |

The containers are top loaded and have built in ejectors to compress and eject waste.

**c. Manpower**

Again it was not possible to collect detailed manpower figures from all of the 34 entities. The thirty companies that replied indicated a work force of 640 persons. However the ACDEP data shows the total figure of 2,130 employees with no breakdown.

Based on the time and motion survey it was observed that most collection trucks are operated only by the driver with no collection crew or only one helper. Waste scattered around the containers is removed by KSK workers or by residents themselves. Only in the case of dump trucks serving individual detached housing were 3 man collection crews observed. Therefore the figures on employees provided by the 34 entities in the ACDEP data are expected to include employees in other activities.

### (2) Operation System

In principle the operation system can be classified into two systems;

- Emptying containers from collection points using side loader trucks equipped with hydraulic side loading devices at block and multi story housing
- Manually removing waste from open stations and in front of doors of individual detached housing

Based on the survey of waste collection trucks arriving at the disposal sites and transfer points, roughly 65 to 70% of the city's waste is collected from containers using the first system.

Another system that was used in Almaty city a few years ago was the hauled container system. Containers of about 5-6 $m^3$ capacity were located at collection points in the city. The collection truck would pick up the container, take it to the dump site for emptying and return to the collection station. Presently this operation system has significantly decreased and the remaining containers are used mostly for commercial waste. The reason given for the decrease was that the containers were not strong and had broken.

After collection from the generation area waste is transported either to the existing transfer station, compost plant (serving as a transfer station) or dump site. The compost plant has been operated as a transfer station since the end of 1998.

At times both facilities are operated together and at other times they are operated alternately. The logic behind the current transfer station operation system was never explained sufficiently to the Study team. It was reported that approximately 250 to 300 tons of waste are transported from the compost plant to Karasai disposal site, and it is possible to transport about 100 t/d from the transfer station when it is operating.

A survey was conducted by this Study to determine the amount of waste entering each of 12 disposal sites during one week in both Winter and Summer seasons. Actual survey results show that daily average total waste at the transfer station and compost plant were 52 and 136 t/d respectively. The largest amounts of waste received at the facilities in a single day (during the survey period) were 66 and 192 t/d respectively.

Of the remaining collected waste, on average 130 t/d was transported directly to Karasai disposal site and the rest was transported to one large site at Spasskaya (average 110 t/d) and other dump sites at locations such as Nika, Barys, and Ala tay.

License numbers and arrival times of trucks are recorded at the transfer facilities and some of the dump sites. Truck scales are available only at the compost plant and transfer station and accordingly waste weights are also recorded. At other sites estimates of waste volumes hauled in are recorded. It is necessary to note that there is little transparency in recording of the amounts of waste collected and destinations. Therefore there are problems in determining the collection coverage rates and amounts of waste legally disposed of.

### (3) Operation Efficiency

#### a. Operation Indices

Table 2.2.5 shows the operation indices derived from the time and motion survey conducted in this Study. Obviously there is a clear relationship between the place the waste is transported to and the time required to collect the waste. Trucks operating in the two southern districts of Medeuskii and Bostandyskii transported their collected waste to Barys and Karasai respectively without using the transfer station. In order to make more than two trips per shift the trucks had to work between 8 and 9 hours.

**Table 2.2.5 Operation Indices**

| District | Ave. Shift time (hr) | Time on collection route (%) | Ave. running distance/ shift (km) | Haul/ trip (t) | Minutes/ ton | Trip/ shift | Ave. one-way distance to D (km) |
|---|---|---|---|---|---|---|---|
| 1. Medeuskii | 8.7 | 45% | 146 | 3.3 | 71 | 2.2 | 28.4 |
| 2. Auezovskii | 7.3 | 35% | 168 | 2.5 | 54 | 3.5 | 23.2 |
| 3. Almalinskii | 9.5 | 41% | 139 | 2.3 | 65 | 3.1 | 20.7 |
| 4. Bostandyskii | 7.9 | 40% | 175 | 2.7 | 71 | 2.5 | 31.0 |
| 5. Zhetysuskii | 6.5 | 57% | 75 | 3.0 | 46 | 3.0 | 8.6 |
| 6. Turksibskii | 6.3 | 45% | 99 | 3.2 | 53 | 2.3 | 17.8 |
| Almaty City | 7.7 | 44% | 134 | 2.8 | 60 | 2.8 | 21.6 |

On the other hand trucks surveyed in Zhetysuskii district transported the waste to the compost plant and therefore managed to make three trips within a shorter shift time of 6.5 hours. Since most of these trucks collect waste from detached individual housing the time spent on the collection route was longer and therefore it was not possible to increase the number of trips to more than three.

Average operating indices for all the surveyed trucks were as follows;

- Haul/trip 2.8 ton
- Trip/ shift 2.8 trips
- Loading time /ton 60 minutes

#### b. Operation Cost

Another indicator for determining efficiency of operation is the cost per ton of collected and transported waste. The 34 collection entities were questioned on their cost breakdowns but the answers returned were not comprehensive and were very variable. However five entities gave breakdowns that were comprehensive in that they included depreciation costs. Their unit costs ranged from 700 to 1,200 KZT per ton in 1998.

However the costs quoted for maintenance and depreciation even by these companies were unrealistically low.

#### c. Collection Service Coverage

(1) Waste Generation Rate

The amounts of waste generated currently in Almaty is estimated to be 959 ton/d, broken down as follows:

- Domestic waste 474 t/d

- Commercial waste 316 t/d
- Medical waste 21 t/d
- Street sweeping waste 77 t/d
- Non hazardous industrial waste 70 t/d

Street sweeping is handled by a specific state enterprise and is discussed in the following section. Non hazardous industrial waste is transported by those responsible for generating the waste or by specialized companies. Therefore the collection service coverage rate needs to be estimated for the three waste categories of domestic, commercial and medical; i.e. an amount of 815 ton/d.

(2) Collection Trucks Availability

Data 1: The Study Team made many requests to the Kazakhs for information on the SWM facilities and equipment available and their ownership conditions. The only data received was the list from ACDEP identifying 264 collection trucks operated by 34 collection companies and KSK's, with no breakdown by age or type. However this figure appears to be high considering the survey results shown as Data 2 and Data 3 below. This was confirmed by interviews with many companies where we were told that many of the trucks are not operating.

Data 2: In August 1999, the Study team tried to obtain further information on the collection trucks by conducting an interview survey. Thirty companies and KSK's responded as shown in Table 2.2.6. In total the trucks numbered 193 units classified by type. However this figure needs to be adjusted upwards because 4-5 companies did not reply to the Study team's questionnaire.

Data 3: During the summer survey the number of collection trucks hauling waste to the transfer facilities and dump sites surveyed was on average 113 units/day and the maximum number used was 189 (only once in the survey period). Therefore only 60% of these trucks operated on a daily basis.

The following steps as shown in Table 2.2.6 were used to estimate the available number of trucks at present.

**Table 2.2.6 Estimation of Available Collection Trucks**

| Truck type | <5 years | 6-10 years | >10 years | Total |
|---|---|---|---|---|
| Step 1 – High Estimate: Breakdown of Data (1) from ACDEP using Data (2) to breakdown numbers by age. | | | | |
| 1) KO | 104 | 19 | 22 | 145 |
| 2) Dump truck | 21 | 63 | 36 | 119 |
| Step 2 – Low Estimate: Adjust Data (1) based on the survey result in Data (3) that operation rate is 60% | | | | |
| 1) KO | 62 | 11 | 13 | 87 |
| 2) Dump truck | 13 | 38 | 22 | 71 |
| Step 3: Obtain the average of High Estimate and Low Estimate | | | | |
| 1) KO | 83 | 15 | 18 | 116 |
| 2) Dump truck | 17 | 51 | 29 | 97 |

Based on this estimate a total truck fleet of 213 units is currently available for collection service.

(3) Available Haul Capacity

The available truck haul capacity is estimated as shown in Table 2.2.7.

**Table 2.2.7 Estimation of Available Truck Capacity**

| Truck type | Age | | | Total | Operation indices | | Haul |
|---|---|---|---|---|---|---|---|
| | <5 yr. | 6-10 yr. | >10 yr. | | Ton/trip | Trip/truck | (ton) |
| 1. KO 413 | 42 | 11 | 15 | 68 | 2.5 | 1.6 | 211 |
| 2. KO 415 | 5 | 0 | 3 | 8 | 8.5 | 1.9 | 98 |
| 3. KO 424 | 17 | 4 | 0 | 21 | 2.6 | 1.6 | 73 |
| 4. KO 431 | 19 | 0 | 0 | 19 | 2.7 | 1.7 | 74 |
| Total KO | 83 | 15 | 18 | 116 | | | 456 |
| 5 GAZ DT | 7 | 17 | 11 | 35 | 2.1 | 1.6 | 85 |
| 6. Zil DT | 10 | 34 | 18 | 62 | 1.7 | 1.6 | 122 |
| Total Dump truck | 17 | 51 | 29 | 97 | | | 207 |
| Total fleet | 100 | 66 | 47 | 213 | | | 663 |

Notes: (1) Operation indices are based on the results of the time and motion and total waste surveys,
(2) In calculating the haul by truck type the operation rates of 85%, 75% and 60% were used for the three age categories of <5 yr., 6-10 yr. and >10yr. respectively.

To summarize the above estimates;

(1) Collection coverage by the private collection companies should cover 815 t/d
(2) 213 collection trucks are available to the collection companies
(3) Available haul capacity is 660 t/d.

Therefore the available haul capacity can cover 80% of the total waste to be collected (660/815 t/d). Consequently the waste collection service coverage of the three waste types; domestic, commercial and medical is estimated to be 75% to 80%.

### 2.2.4 Street Sweeping

The Road Maintenance Board, a joint stock company in Almaty city, is responsible for street sweeping and cleaning. The company's activities are briefly described below.

- The company is jointly owned by Almaty City (71.5%) and its employees 29.5%.
- Street sweeping activity is seasonal and usually implemented during Spring and Summer along with street washing. In Winter and Autumn sand sprinkling on the frozen streets and snow removal activities dominate.
- The company is responsible for about 1,330 kilometers of main streets in the city.
- Three hundred and thirty-four (334) vehicles of different types are used by the company. These include water tankers, street sweeping trucks, sand sprinklers, dump trucks, heavy equipment, passenger cars and buses, etc.. Average age of the trucks is 10.0 years. This year for the first time in 9 years two new street sweepers were purchased. These new trucks are Dutch, but all the others are Russian.
- The company employs 597 persons. These include 140 drivers, 237 sweepers and manual loaders and 49 mechanics.
- The company estimates that a total of 1,187 trucks are required in order for it to fulfil its duties.

### 2.2.5 Issues on Waste Collection and Transport

**1) General**

a. No independent system for determining actual amounts of waste collected by the collection entities

b. Low collection service tariff and collection levels which prohibit renewal of truck fleets, containers and maintenance of collection points

**2) Collection and transport system**

a. Poor condition of containers, insufficient number and inadequate maintenance of collection points

b. Aged truck fleet, low operating rates and frequent breakdowns

c. Inadequate preventive maintenance and washing of trucks

d. No equipment renewal plans

e. Collection system in high density areas (block and multi story buildings) is most appropriate but containers larger than the present 0.64 – 0.75$m^3$ should be considered.

f. Lack of clear collection and transport system for detached individual housing areas of the city, in terms of; collection frequency, discharge to collection points or in front of dwelling, etc.

g. Long distances to the sanctioned city disposal site and insufficient transfer facilities as discussed in item 3) below

h. Lack of communications between KSK collection entities and the residents on discharge regulations

**3) Transfer haul operations**

a. Insufficient capacity of both existing facilities (transfer station and compost plant used as transfer station) to receive majority of city waste

b. No clear long term plan to operate the facilities but rather decision to operate either one or both facilities made on an ad hoc basis

c. Renewal of secondary transport equipment required

d. Complaints by collection entities about transfer facilities refusing to accept waste from individual detached housing with high garden waste contents and long delays at the facilities

## 2.3 FINAL DISPOSAL AND CITY ENVIRONMENT CONDITIONS

### 2.3.1 Present Condition of Final Disposal System

#### 1) General View

Currently, only one landfill site, which is located at Karasai Rayon, is authorized for disposal of Almaty City solid waste. The waste generated in the city should be carried to this site; however, a large amount of waste is illegally dumped in the streets, rivers and on vacant lots. Some waste is transported without permission to other disposal sites outside the city area in the surrounding Oblast territory.

Although ACDEP and the Oblast Department of Environmental Protection have made efforts to control and monitor these activities, the present city waste disposal system is totally uncontrolled and does not comply with the existing laws and regulations. There is a high risk of environmental pollution, such as deterioration of water quality, air pollution (including odor and dust) and rodent and insect infestation, which may affect the health of residents near the disposal sites.

#### 2) Present Condition of the Existing Final Disposal Site at Karasai

The existing final disposal site, with an area of about 29.2 hectares (ha), is located 24.5 km from the western boundary of the city on the Almaty-Bishkek highway. The site was originally a state-owned property, and it has been rented and operated by a joint stock company, Parasat, since 8th December 1998. The contract will expire in 2001.

The site is situated in an environmentally degraded ravine. No residential area exists within 2 km. There are no perennial rivers nearby and the closest river flows from south to west, about 1 km upstream of the site. In terms of the topographical features of the site it is therefore suitable for land-fill.

There were several facilities provided to properly operate and maintain the disposal site; however, all facilities except the administration house are decrepit and no longer used. During the winter season, collection vehicles cannot descend to the landfill area because of snow. Even if the access road gradient were reduced, access would be difficult. Consequently, waste is dumped along the roadside and some is pushed over the cliff. Waste often ignites spontaneously, emitting smoke and reducing visibility.

The landfill area is approximately 2 ha . A retaining dike has been built using site soil on the downstream edge of the landfill. To prevent discharge of leachate generated from the waste deposits directly in to natural streams near the site, two retention ponds have been constructed downstream from the landfill area. These ponds are made of site soil which is mostly silt and clay. Permeation of leachate through these dams is therefore minimal.

The Environmental Survey shows that the double retention system has improved the leachate quality remarkably. The Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the first pond were measured at 40's. By contrast, BOD and COD parameters for the second pond are both around 15. This is close to the level of rivers in the city.

The site is fully covered with clayey soil whose coefficient of permeability is measured at about $10^{-6}$ cm/second. However, based on the result of a groundwater quality survey and soil investigation, it was found that the groundwater of the site is polluted by heavy metals, such as Mercury, Lead and Cadmium.

There are 11 people involved in the operation and management of this site: one (1) chief, one (1) foreman, two (2) registrars, three (3) security guards, and four (4) drivers and operators. All trucks coming to the disposal site are checked at the gate and have to submit a coupon to the registrar or chief of the site.

Parasat, which operates and manages the site as well as collecting waste in the city, issues the coupons at their office. The charge is 90 KZT per cubic meter of waste. Any waste collector can purchase these coupons.

Since the site is not equipped with a truck scale, the volume of waste each truck carries is usually measured by the registrar's eye. According to the Waste Survey, around 50 to 200 trucks come to the site in a day. Total volume of waste delivered is estimated at 250 to 450 tons a day.

Types of waste do not seem to be identified at the entrance. There is no effective control to prevent toxic and hazardous waste from entering the site. Drivers are not instructed where to dump the waste.

The site office is a long away from the dumping area and located at a higher elevation. The truck driver has to decide on the tipping method and area, although the waste is dumped from upstream of the site. There is no regular access road inside the landfilling area, and trucks have to pass through mud where there is some dumped waste but no properly formed access road.

According to the site manager, the existing heavy equipment working at the site is more than 15 years old. Two bulldozers out of a total of four usually move the waste dumped on the site. However, no cover soil can be seen although one excavator is sometimes operated. In addition, one excavator and a water tanker operate at the site. The excavator tries to get cover soil material from small clayey mounds at the site, and the water tanker sprinkles water on the ground near the site office and the access roads.

More than 100 people sort recyclable materials such as bottles, wood and metals from the waste. Many crows and other birds and dogs which may be kept by these waste pickers, can be observed. In these conditions it is difficult to operate the landfill systematically.

### 3) Present Condition of the Transfer Station in the City

Parasat has been operating and managing this facility as well as the former compost plant that is located 1,500 m to the south of Severnoe Koltso. The transfer station is located between the Ozet and Aina-Bulak residential areas and 200m away from Severnoe Koltso. The distance from the site to Ozet and Aina-Bulak is about 800m and 500m, respectively. There are two rivers near the site: Vesnovka on the eastern and Terenkara on the western side of the site.

Piles of waste such as the two rectangular mounds behind the site can be seen. The distance between the two is 200m. These mounds remain from former disposal sites and comprise waste collected from the city over the past 30 years.

The area surrounding these mounds is not used for any specific purpose but is sometimes used for pasture. The surface of mounds is not completely covered with soil although the top of the northern mound is partially faced with concrete. There is some odor from the waste, but there are no flies in the winter season and only a few birds can be seen. A couple of columns of smoke emanate from the western side of the northern mound and drift towards the Ozet residential area, further west of the mound.

A simple questionnaire survey was conducted on 31st March 1999 with the residents near the transfer station, i.e. residents of Ozet, Dorozhnik and Aina-Bulak. Serious unpleasant impacts on residents were not reported, although around 20% of the respondents in Ozet and Dorozhnik and 40% of Aina-Bulak's presently feel uncomfortable with the odor and smoke from the transfer station.

The site of the transfer station originally occupied approximately 2 ha and used to have a transfer system with conveyors and hoppers, warehouse, workshop, and gas station. Old industrial waste such as construction debris, plastic bottles and scrapped containers are scattered in and around of the site. The area of spreading waste covers more than 5 ha.

There was no operating facility at the site during the survey except the administration office near the entrance. This office checks incoming trucks and measures the weight by a truck scale.

Since the transfer system does not function, the edge of the northern mound just behind the station is used for the actual transfer operation. A truck carrying the waste to the station goes up the mound and dumps the waste there. A bulldozer on the mound pushes the dumped waste and drops it from the edge down to a trailer truck waiting below.

Only one person supervises the transfer station and former compost plant simultaneously. Efficient transfer does not occur because huge amounts of waste obstruct effective movement of trucks and the bulldozer. There are around 20 scavengers working at the site.

According to the Environmental Survey, impacts on the ground and surface water by this facility were not observed. Details of the survey results are described in the Supporting Report, Section E, Chapter 3.

**4) Present Condition of the Illegal Dumpsites in the City**

There is a large number of illegal dumpsites varying from trash on the streets and riverbanks to piles of waste in vacant lots in Almaty City. ACDEP presently recognizes 12 sites, and almost all sites have been closed down. Penalties ranging from 4,000 to 10,000 KZT have been imposed.

Two ongoing illegal dumpsites were found during field trips; one is located in the north along Raiymbek Avenue and the other along Spasskaya Street. The other sites no longer operate. The list of dumpsites is included in the Supporting Report, Section E, Chapter 1.

While the Sanitary and Epidemiological Center of Almaty City has been monitoring and reporting the existing condition of street dumps and uncollected waste of communal containers, the situation does not seem to have improved. The primary reason is insufficient capability of transfer facilities and infrequent or irregular collections.

The Rayon Akimates, district offices of the City Akimate, are responsible for monitoring and inspecting sanitary and environmental conditions within their Rayon. Some of the above dumpsites, such as sites in Auezovsky and Zhetysusky, were forced to close when they were reported to the Rayon Akimate.

However, as far as the major illegal dumpsites are concerned, ACDEP has not yet been able to remedy the situation. The flow of information between the City, Rayon Akimate, and ACDEP is very poorly organized.

Some of the dumpsites, for example, in the east to the northwest of Parhach Lake and the intersection of Zhubanov and Saina Streets, had been covered with soil and reclaimed completely. At other dumpsites, even where they have already been closed, construction debris, plastic containers, bottles and other waste remain exposed.

Although the impact on the ground and surface water have not been clear, according to the results of the Environmental Survey, this exposed waste may endanger children who play at the site. From an aesthetic point of view, these closed dumpsites should be covered with soil after removal and gathering of the collection.

As a result of site observation, it seems that most sites received a mixture of domestic, industrial, commercial, hospital and institutional waste. Domestic waste may pollute the soil with organic substances, while industrial waste may introduce not only organic matter but also toxic elements to the soil. There is a lack of information on the soil quality in the above-listed sites although it can be assumed that toxic elements were introduced at these sites by some industries.

### 5) Present Condition of the Existing Final Disposal Sites in Oblast Territory

In addition to the above-mentioned dumpsites in Almaty City, it was found that seven (7) sites in the territory of the Oblast are operating and receiving waste from the city. The names of these sites are Nika, Barys, Karasu, Enbek, Boralday, Rikki and Alatau. The first six names are names of their operation companies. These companies originally collected domestic waste from villages or small districts located beyond of the city boundary. These sites have been accepting waste not only from villages but for the past one or two years they have also been accepting waste from the city because they receive tipping fees from incoming trucks.

Except for the Alatau site, the Almaty Oblast Department of Environmental Protection had authorized these sites and already recognized the situation. So far the Department and Rayon Akimate which are apparently responsible for monitoring the dumpsites have not been able to stop their operation.

According to a report on state environmental examination by the Almaty Oblast Department of Environmental Protection, these sites were designed as sanitary landfills. However, the actual sites contain none of the features included in their design.

In six (6) sites out of nine (9), i.e., Nika, Barys, Karasu, Enbek, Boralday and Alatau, only one bulldozer is used for moving waste, while a cell type of landfill with cover soil is required in the original design. The bulldozer sometimes breaks down, and there is usually no equipment at the site.

At the sites of Karasu, Enbek and Boralday, site offices with a gate for checking trucks have been set up. With respect to site management, the concept of sanitary landfill was not found at any site. There are scavengers at almost all sites varying from 3 to 20 people.

In the sites of Nika, Barys, Boralday and Enbek, smoke from piles of dumped waste can be seen. Although there is no actual data regarding air quality around these sites, it can be assumed that smoke due to burning of waste worsens the air quality of the place.

The original landfill design requires the use of clay foundation to protect the soil and groundwater at the site. Since the actual site conditions do not meet this requirement, there is a high possibility of soil and groundwater contamination from hazardous substances.

### 2.3.2 Environmental Quality of Almaty City

#### 1) Water Quality

#### (1) Surface Water

Two major mountain rivers, i.e., the Malaya and Bolshaya Almatinkas, go through Almaty City from south to north. They start from the Za-Illi Alatau Mountains and glaciers of these mountains feed these two rivers. Their inflows and tributaries, namely, Vesnovka, Remisovka, Kasachka and Karasu, flow through the city parallel to the two Almatinkas.

There are several monitoring points set up along the two rivers in and outside of Almaty City. The Department of Hydrometeorology in Kazakhstan, in spite of changes of the government structure, has been conducting water quality analysis since 1988.

Focusing on Suspended Solids (SS), Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD), the latest analysis in November and December 1998 clearly illustrates that the two rivers were gradually polluted from the upstream to the downstream. This is understandable because the major sources of contaminants seem to be the polluted run-off of surface water and domestic wastewater.

The Malaya Almatinka is in general cleaner than the Bolshaya. The water quality is measured as Category II (clean) for the Malaya and Category III (moderately polluted) for the Bolshaya Almatinkas

#### (2) Groundwater

Unfortunately, the quality of groundwater in Almaty City is not given although a water supply company, the Ministry of Geology, and related organizations are supposed to keep periodic records. According to a staff engineer of the Vodokanal State Communal Company, which deals with water supply and wastewater treatment in Almaty City, 70% of the city's water supply comes from groundwater.

The company operates 17 pumping stations comprising 6-10 wells to supply chlorinated groundwater for the city. Although the depth of groundwater taken used to be 100-150 m, the water is now usually pumped up from 200 to 300m in depth because of contamination.

Therefore, it is said that groundwater quality is, in general, presently satisfactory for all domestic purposes. However, some of the wells provide water that recorded values in excess of the standards in the Environmental Survey (see Supporting Report, Section E, Chapter 3 for details).

### (3) Standards

With respect to drinking-water quality, *Drinking Water and Water Supply for Localities, Hygienic Requirements to Quality of Centralized Water Supply*, SNIP 2.1.4.559-96, Moscow 1996, is widely applied in this country. SNIP, abbreviation of the *Basic Standards, Norms and Regulations* in Russian, established during the USSR period, covers not only environmental issues, such as water, air, soil, flora and fauna, but also regulates economic activities. In addition to SNIP, the National Standards called GOST are also used. GOST 2874-82, *Drinking Water: Hygienic Requirements and Quality Control*, regulates the quality of drinking water.

The surface water quality is regulated using the maximum allowable concentration factor called PDK (Russian abbreviation). The PDK is defined as the ratio of a measurement value to the maximum allowable value in each parameter. The maximum allowable value of PDK is shown in the Supporting Report, Section E, Chapter 2.

## 2) Air Quality

Air quality may be influenced by moving (mostly traffic) or stationary (most industrial) sources. Several monitoring points have been set up inside the city, and the Department of Hydrometeorology in Kazakhstan has also been measuring the air quality as well as the water quality since 1988.

The survey results show that both average and maximum PDK have been increasing since 1990 up to 1992 or 1993. After 1994 the air quality of the city reached the allowable level except formaldehyde, on average, although the maximum PDK of dust and carbon oxide (CO) still exceeded the allowable level, i.e., PDK is 1.0. Both average and maximum PDK of carbon monoxide (CO) declined dramatically between 1995 and 1998.

Monthly average PDKs from 1988 to 1998 indicate that there are higher values of PDK for carbon monoxide (CO) during the winter period from October to March. This seems to result from burning coal and wood for heating.

Air quality is regulated using the maximum allowable concentration factor (PDK). The maximum allowable value of PDK is shown the Supporting Report, Section E, Chapter 2.

## 3) Soil Contamination

Unlike the water and air quality survey the measurement of soil contamination for Almaty City does not have a long history. A map, *Environment Map of Almaty City*, showing degree of soil contamination is available. This map covers the city area and was made by analyzing samples taken from the surface to a depth of 10 cm.

According to the map, soil contamination can be observed at pollution sources that are mainly located in industrial areas. These pollution sources are locally distributed, and the area of pollution is spreading out from these sources.

The former compost plant is one with a high degree of contamination. Contaminants detected at the site include lead, zinc, mercury, fluorine, arsenic and cadmium, all of which are classified first degree hazardous elements. There is no other specific information regarding soil contamination.

The degree of contamination is evaluated not by the maximum allowable concentration but by a background concentration, which may be established based on previous data and reasonable levels by experience. The background concentration and degree of soil contamination are shown in the Supporting Report, Section E, Chapter 2.

**4) Flora**

The southern part of Almaty City is designated as one of the areas of the Alatau National Parks. Deciduous and coniferous forests at an altitude of 1,100 to 1,500m above sea level can be seen in these areas. Many trees, such as apple, apricot, silver birch, poplar and hawthorn, as well as pastures of feather-grass, sheep's fescue, couch-grass, small-reed and thousands of other plants, grow in this area.

In the residential and commercial areas of the city including downtown, there are oaks, poplars, silver birches, apple trees and central Asian willows planted along the roadsides. A large number of aged plants exist, and lack of new planting and inadequate water supply system for trees are major constraints in development of vegetation in the city. It is said that these result from lack of funds.

**5) Fauna**

The only place where fauna can be discussed is the southern part of the city. In the mixed forests, roe deer, wild boar, badger, fox, ermine, mouse-like rodents and a wide variety of birds can be seen occasionally.

*The Red Data Book of Kazakhstan* shows that there are 17 species of animals that probably live in this area. However, it is considered that these animals no longer exist inside the city boundary. There is no information regarding birds and insects.

## 2.4 RECYCLING AND WASTE MINIMIZATION

### 2.4.1 Present Conditions of Recycling Companies

To understand the present situation of recycling in Almaty city, interviews were conducted with companies involved in recycling activity during March 1999 as follows.

| | Name of company | Material |
|---|---|---|
| 1 | Kaz Vtorchemet SHC | Ferrous metal scrap |
| 2 | Vtorma SHC | Paper |
| 3 | Vtortzvetmet SHC | Non-ferrous metal scrap |
| 4 | Almatytortzvetmet | Non-ferrous metal scrap |
| 5 | Almaty affiliate of Kaz Vtorchemet | Ferrous metal scrap |
| 6 | Byrlesu SHC | Textile |
| 7 | Sunkar SHC | Plastic, Polyethylene, Polystirol |
| 8 | Almaty Tara SHC | Paper |
| 9 | Polymer Tara SHC | Polyethylene |
| 10 | Obis | Plastic |
| 11 | Zharys | Paper |
| 12 | Parasat SHC | Paper |
| 13 | Al-Afi | Paper |
| 14 | Alau JV | Glass (Since 1994, activity is stopped) |
| 15 | Waste Processing Plant | Composting (operated as a transfer station) |

Recycled amount in 1998 is shown in Table 2.4.1. Materials treated in these companies are ferrous metal scrap, non-ferrous metal scrap, paper, plastic and textiles. Total amount of recycled materials was 29,344 ton, of which 22,440 ton (76%) was ferrous metal and 5,084 ton (17%) was paper. Only 64 ton/year of plastic was recycled in 1998.

Based on the results of the interviews, total income through the recycling of waste in 1998 was estimated at 63 million KZT as shown in Table 2.4.1.

### 2.4.2 Recycled Material

#### 1) Ferrous metal

Ferrous metal is recycled through Kaz Vtorchemet SHC and it's affiliate. The final user of ferrous metal is the Ispat Karmet company located in Karaganda. The price of ferrous metal scrap is priced between 650 – 1,000 KTZ/ton. Recycled amount of ferrous scrap was 22, 440 ton in 1998.

#### 2) Non-ferrous metal

Non-ferrous metal is recycled through Vtorzvemet SHC and its affiliate. Final users of non-ferrous scrap are plants in Balkhash. Prices of non-ferrous scrap are as follows:

| | |
|---|---|
| Lead | 10,000 KZT/ton |
| Aluminum | 25,000 KZT/ton |
| Copper | 50,000 KZT/ton |

Recycled non ferrous scrap was 1,680 ton in 1998 as shown in Table 2.4.1.

### 3) Paper

Paper is recycled through 5 companies as shown in Table 2.4.1. Final users of waste paper are cardboard companies located in Pavlodar city. The price of waste paper is between 500 - 1,160 KZT/ton. Recycled amount through the above 5 companies was 5,084 ton/year in 1998. It is noted that waste paper recycling has decreased, as follows.

| | |
|---|---|
| 1995 | 3,321.5 tons |
| 1996 | 2,876.0 tons |
| 1997 | 1,716.0 tons |
| 1998 | 340.0 tons |

### 4) Plastic

Plastic is recycled by 3 companies. The recycled amount is 64 ton/year and price of waste plastic is between 6,000 – 45,000 KZT/ton

### 5) Others

As mentioned in section 2.3, there are waste pickers at the disposal sites and transfer stations collecting cardboard, glass bottles, plastic bottles and tins.

## Table 2.4.1 Amount of Recycling in Almaty City

| | Material | Company name | Capacity | Actual amount | Raw material Price (KTZ) | Total price (1,000 KTZ/y) | Final user | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | Ferrous metal scrap | Kaz Vtorchermet S.H.C. | 36,000 t/y | 1.440 t/y | 1,000 /ton | 1.440 | Ispat Karmet in Karaganda | |
| | | Almaty affiliate of Kaz Vtorchermet S.H,C. | 30,000 t/y | 21,000 t/y | 650 /ton | 13,650 | Same as above | |
| | | Total | | 22,440 t/y | | 15,090 | | |
| 2 | Non ferrous metal | Vtorzvetmet S.H.C. | 3,500 t/y | 380 t/y | 10,000-40,000 | 9,500 | Plant in Balkhash | |
| | | Almaty Vtortzvetmet | 12,000 t/y | 1,300 t/y | 10,000-40,000 | 32,500 | Same as above | |
| | | Total | | 1,680 t/y | | 42,000 | | |
| 3 | Paper | Vtorma S.H.C. | 4,000 t/y | 2,000 t/y | 600 | 1,200 | Cardboard factory in Pavlodar | |
| | | Almatt Tara S,H,C, | 4,000 t/y | 2,000 t/y | 500 | 1,000 | Same as above | |
| | | Zharys | 1,200 t/y | 800 t/y | 600 | 480 | Same as above | Cardboard |
| | | Parasat S.H.C. | 264 t/y | 264 t/y | 1,160 | 306 | Poultry company in Almaty | Egg tray |
| | | Al-Afi | 400 t/y | 20 t/y | 1000 | 20 | Cardboard factory in Pavlodar | |
| | | Total | | 5,084 t/y | | 3,006 | | |
| 4 | Plastic | Sunkar S.H.C. | 2,000 t/y | 0 | 40,000 | 0 | Sunkar in Almaty | |
| | | Polymer Tara | 170 t/y | 50 t/y | 45,000 | 2,250 | Polymer Tara | Polyetylene |
| | | Obis | 14 t/y | 14 t/y | 6,000 | 84 | Internal use | Granules bottles |
| | | Total | | 64 t/y | | 2,3340 | | |
| 5 | Textile | Byrlesu S.H.C. | 3,000 t/y | 80 t/y | 6,740 | 539 | Purchased by workers | |
| | | Total | | 80 t/y | | 539 | | |
| | TOTAL | | | 29,334 t/y | | 62,969 | | |

S.H.C. Share Holding Company

## 2.5 NON-HAZARDOUS INDUSTRIAL WASTE AND MEDICAL WASTE

### 2.5.1 Existing Situation for Non-hazardous Industrial Waste

The evaluation of the existing situation is the basis for elaborating the future structure of the waste management system, developing alternatives and showing feasible solutions concerning waste management.

Kazakhstan's gross national product has decreased since 1993 by more than 50%. This is closely related to the decline in industrial production, which decreased greatly in 1998 compared to 1993. The reduction of industrial production leads to a consequent reduction of industrial waste.

#### 1) Definition and statutory requirements

Over the past five years the Government of Kazakhstan has made enormous efforts to introduce several laws and regulations to protect public health and the environment.

The term "waste" implies any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of an enforced national law. One can differentiate between

- Municipal waste: domestic refuse, as well as commercial or trade refuse and other waste whose nature or composition is similar to domestic waste;
- Industrial waste: waste produced by manufacturers or industrial activities or processes;
- Hazardous waste: any waste specified in the "temporary classifier of toxic manufacturing waste and methodological recommendation on assessment of class of toxicity of manufacturing waste" (Moscow 1987).

This type of waste is classified in 4 classes according to a certain toxicity factor. It doesn't seem to be very clear whether the classification relates to regulations and care to be taken for the personnel and factory workers in order to keep their working conditions safe, or to the waste classification, as generated in the factories.

If the regulation relates to waste classification generated in the different factories, it becomes difficult to distinguish between the different sources of waste generation. Furthermore some waste types normally classified as "highly hazardous waste" such as asbestos will, according to the regulation, be grouped in Class IV, which means "the least dangerous class".

#### 2) Industrial waste records

ACDEP issues Authorization to the industrial companies allowing them to dispose of industrial waste at the municipal landfill site.

In total 394 industrial establishments within the Almaty City administration boundary are recorded at ACDEP and are authorized to transport waste to the landfill site. The document authorizes the establishment to generate a specified quantity of waste. The actual amount of waste generated is not being recorded.

Three published reports were found in ACDEP. "Almaty Ecologostroy" prepared two reports in 1996 and 1997. Both reports describe a preliminary assessment of the solid waste management system in Almaty.

ACDEP published a report in 1998 about the ecological situation and its improvement in Almaty. The largest enterprises generating high amounts of industrial waste are summarized. The waste is categorized according to the 4 toxicity classes. (See Section 2.5.3: Industrial waste quantity).

**3) Issues**

It is recommended to refer the toxic waste classification to international standards. The principal aim of the regulation should be to formulate a common definition of hazardous waste and introduce greater harmonization of the management of such waste. It should list hazardous waste and constituents and properties, which render waste hazardous.

Reference can be made to the Bazel Convention and the Directives published by the EU (91/689/EEC of 12 December 1991. Refer to the Supporting Report).

It is further recommended to establish a monitoring system in order to regularly record all types of industrial waste that are generated.

### 2.5.2 Survey on Non-hazardous Industrial Waste

In order to achieve a wide range of detailed information about industrial waste regular records should be maintained. Within the present Study a questionnaire has been carried out. From the 394 registered industrial factories in the Almaty City area, the following 11 have been chosen for the case study based on discussions with the Kazakh counterparts and after determining which companies are in a position to provide the required information:

**1) AZTM Machine-Building Plant**

AZTM Company manufactures rolling mills, draw benches and their spare parts. The production capacity has continued to decrease since the collapse of the former communist regime. Production for the past years are shown in the following Table 2.5.1.

**Table 2.5.1 Goods Production**

| Year | Production |
|---|---|
| 1998 | 1,711 t |
| 1997 | 2,456 t |
| 1996 | 3,854 t |
| 1995 | 4,201 t |

The waste generated has also decreased proportionately. It consists mainly of foundry loam and metal scrap. Due to the important personal staff and their accompanying infrastructure (such as canteen, Kindergarten etc.) a certain amount of domestic waste is also generated.

The industrial waste generated in the last years is presented in the following Table 2.5.2.

**Table 2.5.2 Industrial Waste Production**

| Year | Waste generation |
|---|---|
| 1998 | 2,941 t |
| 1997 | 3,461 t |
| 1996 | 5,955 t |
| 1995 | 6,365 t |

The ratio between production and waste generation is high. The highest ratio for 1998 is more than 1.7, i.e. for each ton of goods produced 1.7 tons waste have been generated.

In order to be in line with the overall environmental protection policies some improvements in the process used by the AZTM Company should take place to reduce the proportion of waste generated.

### 2) Beverages Manufacturing (AO Bachus)

The Bachus Company is one of the biggest factories in Almaty producing alcoholic beverages. With 280 employees the company fills some 120,000 bottles per day. The waste generation and waste management situation has been altered recently. Glass was not accepted for disposal at the landfill. Old glass has been collected and given to a glass recycling company (State Company) that no longer exists. Other alternatives have also been tested such as exporting old glass for recycling. 650 tons of old glass collected over 3 years, have been sent to Russia for recycling in 1997. Due to non-profitability the issue of export has been abandoned.

Presently all waste is transported to the landfill. The total waste generated amounts to approximately 60 t/year old glass. The generation of cardboard waste in not significant.

There are approximately 70 Beverages Companies. 8 have similar production capacity. The rest of them are small companies. Based on the existing beverages companies within the boundary of Almaty City, the amount of old industrial glass is estimated as follows:

$$8 \times 60 \text{ t/year} + (70-8)/4 \times 60 \text{ t/year} = 1{,}410 \text{ t/year}$$

### 3) Non-ferrous Metal Recycling Company - VTORZVETMET

VTORZVETMET is a private collecting and recycling company for non-ferrous Metal in Almaty. The plant is not working due to the transitional economic problems.

Installed plant capacity is 300 ton/month. Due to the actual situation only 5 persons are employed. In the last years the actual production was zero. The following Table 2.5.3 shows the quantity of non ferrous metal scrap that has been recycled by the company in recent years

**Table 2.5.3 Quantity of Recycled Metal Scrap**

| Year | Production |
|---|---|
| 1998 | 1,200 t |
| 1997 | 3,500 t |
| 1996 | 3,000 t |
| 1995 | 2,500 t |

For the current year it is expected that about 1,500 t will be processed.

The company mainly enters into one-year contracts with its suppliers and buyers. There is strong competition amongst numerous private (50 – 70) companies acting in the non-ferrous metal recycling market.

### 4) Ferrous Metal Recycling Company - KAZVTORCHERMET

Kazvtorchermet is a State-Run Enterprise employing about one hundred persons.

Due to the current economical transition phase the plant is running at 4,000 t/month capacity. The plant would easily be able to extend the capacity to 12,000 t/month scrap metal recycling. The personal staff would be increased as well to 200 workers (as it was).

Two kinds of ferrous metal are accepted: thicker than 5mm (category 5A) and thinner than 5 mm (12A category); metal is cut, compacted and exported by rail to Russia and China.

The company has its own trucks (10-15) for transporting metal from its suppliers and is competing with 10-15 private companies significantly smaller in size and capacity.

The actual price that the Company pays for metal thicker than 5mm (category 12A) amounts to 800 KZT/ton; and for metal thinner than 5 mm (category 5A) to 150 KZT/ton. The price for cast iron is about 1,029 KZT/ton.

### 5) Adako Joint Stock Company (Woodworking Enterprise)

The woodworking enterprise produces panels and frames for windows and doors. The nominal plant capacity amounts to 3,000 $m^2$ wood per month. The actual real production is about 30% of its nominal capacity where only 40 workers of 100 personnel staff are engaged. The production rate of the company has changed. In 1998 the plant could run at 80% of the nominal capacity to satisfy the high (state) demand in construction of the new capital city Astana.

Raw timber is imported mainly from Russia.

Waste generation varies with production. According to the nominal capacity of the plant the expected waste generation amounts to:

- 1 t per month sawdust (1.3 $m^3$). Akado is contracting a poultry company to buy the saw dust for their purposes,
- 15 t bark, that is composted in the plant.

Adako seems to have solved the waste generation problem. The non-hazardous industrial waste (wood) generated shall be estimated considering a plant capacity of about 60%. The waste generation will amount to approximately:

- 2 t per month sawdust
- 30 t bark.

### 6) Nur Alem Joint Stock Company (Slaughterhouse)

The Nur Alem Joint Stock Company was formerly one of the biggest slaughterhouse in Kazakhstan with some 5,000 employees.

Daily the following numbers of livestock were slaughtered:

- 14,000 sheep,
- 1,500 pigs,
- 1,000 cattle and
- 30,000 poultry

Processing amount to 260 t/day meat, 50-60 t/day sausages and 1,000 cans of preserved food (meat).

Within the privatization process the company has been operated from 1991 to 1993 as a private company showing promise in benefits. Since 1993, when the company was reconverted to a state company, the economic and financial situation of the slaughterhouse has deteriorated.

The company has been divided into 8 independent factories since the beginning of 1999, three of them joint ventures with Indian, Iranian and South Korean companies. Actually the companies are not working at all. It has been reported that in the best case the plant will operate at 20% of nominal capacity capital. From September through December, the plant works at full capacity but not in spring when livestock are in poor condition.

The Study team could not get any figures or records of solid waste generation for now or past years. According to experience the waste generation could reach following figures, assuming production will grow slowly until it achieves 20% of former capacity:

Offal waste: 0.005 x (1500+1000) x 0.2 + 0.0002 x (14000+30000) x 0.2
= 4.5 t/day

Unhealthy animal (0.02%):
0.0002 x (1500+1000) x 1000 + 0.0002 x (14000 x 20+30000)
= 560 kg/day

Horn 2 x 1500 x 0.5 x 0.1 = 150 kg/day

The total waste generation under the best operating conditions (20% of the nominal capacity) will amount to approximately 1,615 t/year

### 7) SUNCAR Joint Stock Company (Plastics Manufactory)

The Suncar Joint Stock Company manufactures plastic goods. Production decreased in the last four years to just over 1/3 of plant capacity (from 162,000 t in 1995 to 48,700 t in 1998). Waste generation decreased from 24 t in 1995 to only 3 t in 1998.

The plant is equipped with a line having the technology to use old plastic as raw material. The plant can recycle up to 2,000 t/year old plastics (HDPE, LDPE, Polystirol, PP excluding PET). The following figures show the quantity of waste produced and recycled old plastic

**Table 2.5.4 Plastic Waste Production**

| Year | Turnover | Waste generated | Waste recycled |
|---|---|---|---|
| 1998 | 48,743 KZT | 123 t | 120 t |
| 1997 | 67,906 KZT | 255 t | 250 t |
| 1996 | 124,281 KZT | 188 t | 180 t |
| 1995 | 162,566 KZT | 164 t | 140 t |

### 8) NAR Shoes Factory (Zhetysu)

This factory (formerly Zhetysu shoe factory) was one of the biggest factories producing shoes in Kazakhstan. Annual production dropped from a historic high of 11 million pairs of shoes to 1 million in 1994 and just 130,000 pairs in 1996/1997. The plant is presently not running and waiting for financial support to survive.

Likewise waste production dropped from 18 tons in 1994 to 4 tons in 1998. For the current year no waste has been generated, because no shoes have been produced. The different types of waste that were generated are:

- Leather (natural and synthetic)
- Textiles (natural and synthetic)
- Synthetic fur
- Cardboard
- Different types of resin

The following Table 2.5.5 shows the decreasing amounts of waste generated at the NAR shoe factory during the last years.

**Table 2.5.5 Waste Quantity generated in the last years**

| Year | Waste generation |
|---|---|
| 1998 | 0.02 t |
| 1997 | 4.0 t |
| 1996 | 4.3 t |
| 1995 | 6.4 t |

Due to the current critical economical situation it is expected that for the current year no waste will be generated at all.

### 9) Tobacco Manufacturing

The Tobacco factory in Almaty was privatized in 1994 and is operated by the multinational Philip Morris. They employ about 1,500 workers. A new plant is currently under construction outside Almaty City (within the Almaty Oblast territory) and the company is supposed to move there within the next few months. The waste generated will be considered as coming from Almaty Oblast and not the City. We have not received any answer to our questionnaire.

### 10) Power Plant TEZ 1

TEZ 1 the power plant visited is located within the Almaty city boundary and supplies a part of the population with electric power (650 MWh/year), and heating. In addition it delivers process steam for certain industries surrounding the plant.

The 7 units of the plant are equipped with different types of firing systems using different combustibles for energy production, heavy fuel, gas as well as coal.

The coal comes from Kazakhstan's northern region of Karaganda and has a high calorific value (about 5,000 kcal/kg) but its combustion generates a huge quantity of ash (fly ash and bed ash/slag).

Coal consumption averages 300,000 t/year and the annual ash production is approximately 100,000 t about 95% fly ash and 5% bed ash (slag). Some 2.1 million tons may have been disposed of since the landfill commenced operation in 1978.

The ash generated at the power station is mixed with water in a ratio of approximately 15% ash and 85% water. The liquefied waste is pumped through 8.5 km pipes to the dumping site close to Zarya Vastoka located about 7.0 km east of the power plant. Water is recovered at the dumping site and re-pumped to the plant for further ash transport.

The ash landfill site at Zarya Vastoka is rudimentary and located in a very sensitive area. The River Terenkara that has been slightly diverted belongs to a large water catchment area. According to the ecology department of the power plant, the landfill site has an appropriate base line system with an impermeable soil layer. Therefore no drainage system was provided for the rainwater and the water used for the ash transport and no control device for groundwater is installed.

### 11) Municipal Waste Water Treatment Plant

The Municipal Waste Water Treatment Plant started operating in 1984 and its design capacity is 640,000 $m^3$/day of domestic wastewater as well as industrial wastewater (prior to local treatment), and rain water run-off. Following treatment the water is discharged into the Sorbu Lake through open water channel (or into the Illi River). At present the plant is treating 480,000 $m^3$/day, and in 1998 an average of 520,000 $m^3$/day waste water was treated.

All industries discharging wastewater into the Almaty sewage system fulfil the required standards concentration limits in order to not overload the municipal waste water treatment plant (e.g. in discharging any hydrocarbon components).

The Municipal Wastewater Treatment Plant in Almaty generates several types of waste. The collected screenings amount that is caught at the first mechanical treatment stage averages 1$m^3$/day and is disposed of (illegally) in an area close to the bigger Almatinka River (between the zone of the mechanical waste treatment and biological treatment zone of the plant). The sand collected at the second stage of the mechanical treatment amounts to approximately 3.5 t/day. The sand field is stored at the plant, dried and used for any rehabilitation work purposes (trenches, pipes).

The sludge generated after wastewater treatment averages 1.46 million $m^3$/year ( 4,000 $m^3$/h) with a water content of approximately 98%. The sludge is pumped 7 km through pipes to an area located about 10 km north of the treatment plant where it will be dried. The disposal site for drying sludge is about 29 ha large and covers 28 slots. Each slot has a surface area of about 8,000 $m^2$.

Tests and analyses are carried out continuously at the Wastewater Treatment Plant at different stages of the treatment (after mechanical treatment, biological treatment generating sludge). The detailed results of the analysis are given in the Supporting Report.

The sludge is analyzed when it is discharged after drying. The results of this analysis are shown below:

**Table 2.5.6 Results of Sludge Analysis**

| Components of Sludge | Discharged sludge | Dried sludge |
|---|---|---|
| Moisture | - | 97 % |
| Ash Content | - | 54 % |
| Ca | 1.9000 g/kg | 5.200 g/kg |
| Ti | 0.0670 g/kg | 0.059 g/kg |
| Cr | 0.0025 g/kg | - |
| Cu | 0.0650 g/kg | 0.031 g/kg |
| Zn | 0.1500 g/kg | 0.120 g/kg |
| Fe | 3.7000 g/kg | 3.130 g/kg |
| Zr | 0.0300 g/kg | 0.034 g/kg |
| Sr | 0.0530 g/kg | 0.045 g/kg |
| Br | 0.0040 g/kg | - |
| Pb | 0.0370 g/kg | 0.037 g/kg |

The treated waste water is reused as irrigation water or for fisheries. The content of some components (such as heavy metals, minerals, hydrocarbon substances etc.) are regulated. In order to ensure the degree of treatment of the wastewater necessary to enable discharge into the Sorbu Lake (or Illi River), certain limits should not be exceeded. The standard limits are shown in the following Table 2.5.7.

**Table 2.5.7 Standard Limits for Treated Wastewater**

| Components | Limit Standards Sorbu Lake | Limit Standards Illi River |
|---|---|---|
| Dissolved Minerals | 1,000 mg/l | 1,000 mg/l |
| $BOD_5$ | 17 | 3 |
| Nitrogen Nitrite | 3.300 mg/l | 0.020 mg/l |
| Nitrogen Nitrate | 45.00 mg/l | 9.100 mg/l |
| Hydrocarbon Substances | 1.000 mg/l | 0.050 mg/l |
| Iron (Total) | 5.000 mg/l | 0.100 mg/l |
| Copper | 0.200 mg/l | 0.001 mg/l |
| Zinc | 2.000 mg/l | 0.010 mg/l |
| Lead | 0.200 mg/l | 0.100 mg/l |
| Cadmium | 0.030 mg/l | 0.005 mg/l |
| Chrome | 0.100 mg/l | 0.020 mg/l |

### 2.5.3 Non-hazardous Industrial Waste Quantity and Nature

From the industrial survey, carried out by the Study team the following waste generation can be summarized.

**Table 2.5.8 Surveyed Enterprises**

| ENTREPRISE | PRODUCTION | CAPACITY OF PRODUCTION (100%) | TYPE OF WASTE | QUANTITY OF WASTE | TREATMENT & ELIMINATION |
|---|---|---|---|---|---|
| AO Bachus | Beverages | 120,000 bottles/day | Mainly Glass | 60 t/a | Landfill Karasai |
| AZTM JSC | Metal processing, Foundry | 8,000 t steel /year | Foundry sloam, metal scrap | 12,250 t/a | Landfill & recycling of metal scrap |
| ADAKO JSC | Doors, Windows, Wood processing | 3,000 $m^3$ Wood/Month | Sawdust, Bark | 1t sawdust 15t bark per Month | Recycling (Composting) |
| Nur Alem JSC | Abattoir | 2,800 sheep, 300 pigs, 200 cattle, 6,000 poultry /day | Offal, Horn, Meat | 1,615 t/year | Landfill Karasai |
| SUNKAR JSC | Plastic | 2000 t/j | - | - | - |
| PHILIP MORIS | Tobacco | - | - | - | Landfill Karasai |
| TEZ 1 | Energy | 650 MWh/year | Mainly ash | 300,000 t/a | Landfill |
| MWWT Plant | Wastewater Treatment | 520,000 m3/day | Sludge, sand | 4,000 m3/h & 3.5 t/day | Landfill & internal use of sand |

**Table 2.5.9 Surveyed Potential Recycling Enterprises**

| ENTERPRISE | RECYCLED RAW MATERIAL | QUANTITY (100% capacity) | ACTUAL RUN-NING CAPACITY | REMAINING CAPACTY |
|---|---|---|---|---|
| KAZVTORCHERMET Ferrous Metal | Ferrous Metal scrap (category 5A and 12A | 12,000 t/month | 4,000 t/month | 8,000 t/month |
| VTORZVETMET Non Ferrous Metal | Non Ferrous Metal scrap | 300 t/month | 120 t/month | 180 t/month |
| SUNKAR JSC | Plastics (HDPE, LDPE, etc. excluding PET) | 2000 t/a | 0 | 2,000 t/a |

In order to have real figures on the quantity of industrial solid waste generated in Almaty records should be continuously maintained by all registered companies producing industrial waste.

The ACDEP records the total waste as that registered in the Authorization rather than measuring actual waste generated.

Registered industrial companies and the allowed "authorized" amounts of waste have been compiled by the Study team and are presented in the following Table 2.5.10.

**Table 2.5.10 Industrial Waste Quantity allowed to be disposed of at the Municipal Landfill Site**

| Company | Waste quantities (t for1998) |
|---|---|
| Metal Processing | 6,904.854 |
| Oil Processing & Oil Products | 597.000 |
| Car & Transport | 42.500 |
| Building Construction | 4,695.600 |
| Plastic Processing | 134.960 |
| Glass Processing | 792.000 |
| Wood Processing | 391.400 |
| Leather Processing | 1.750 |
| Food Processing | 1,656.500 |
| Others | 10,165.935 |
| | |
| **Total** | **25,382.499** |

Accordingly 394 registered companies are allowed to dispose of some 25,382t of industrial waste at the municipal landfill site in Almaty. Waste coming from the Power Station is not taken into consideration; probably because no authorization is required to use landfill site. The plants have their own disposal site where ash and slag become land fill.

Studies were carried out by the "Almaty Ecologostroy" (1996 and 1997) and by the "Almaty City Department of Environment" (1998) about the existing industrial waste situation.

According to the report issued by ACDEP, the quantity of industrial waste generated in Almaty amounts to a total of 13,160 t in 1998, where 10,970 are liquid and 2,190 t are solid waste. The Supporting Report presents the details of waste generated in 1997 (according to the Almaty Ecologostroy study).

The report issued by the Almaty Ecologostroy classifies industrial waste according to four toxicity classes given in the regulation of "Temporary classifier of toxic waste – Moscow 1987".

The following Table 2.5.11 summarizes the reported waste quantity that is generated in 1997 in Almaty:

**Table 2.5.11 Industrial Waste Production in Almaty**

(According to Almaty Ecologostroy Reports)

| Toxicity class | Waste generation as of 01.01.96 |
|---|---|
| I | 0.027 t |
| II | 508.0 t |
| III | 74.1 t |
| IV | 511.3 t |

In these quantities the ash and slag generated at the Power Station (TEZ 1) in Almaty are not taken into consideration. The quantity of ash and slag generated at the Power Station TEZ 1 amounts to 1.15 millions t in 1998 according to the report.

Because some waste categories are not listed in these reports, the existing recorded data should not be considered as reliable and representative. It can be regarded only as an indication of current trends.

### 2.5.4 Industrial Waste Treatment Methods

Apart from disposal to landfill (at present contracted to the Collection Companies) industrial waste recycling is generally the most effective means of treatment from the point of view of waste volume reduction and more effective use of resources. The following describes some simple techniques of non-hazardous waste treatment and recycling.

#### 1) Sorting

Sorting techniques are generally applied in combination with crushing techniques for the following purposes:

- Extraction of valuable substances (reusable)
- Separation and collection of valuable substances and organic materials immediately prior to recycling
- Separation of combustible and non-combustible materials from mixed waste as pretreatment in land filling and incineration
- Separation and collection of valuable substances

#### 2) Compression and Cutting

Compression processes for various types of industrial waste ensure reduction in waste volume, which is one of the objectives of immediate treatment.

#### 3) Destruction and Crushing

Destroying and crushing processes reduce industrial waste volume and meet one of the requirements of immediate treatment. They also comprise an effective pretreatment method in the filling-up operation.

#### 4) Dehydration and Extraction

Dehydration is mainly applied to sludge. In chemical engineering, the term "extraction" means a process of dissolving and separating soluble components contained in a solid or liquid raw material.

#### 5) Drying and Concentration

To dry waste is to evaporate and separate water from wet waste and reduce the residual water content. Drying reduces volume and stabilizes their state.

#### 6) Thermal Decomposition

Thermal decomposition is also called dry distillation and is applied to treatment of cellulose and plastic organic substances. It is a chemical reaction in which these substances are heated in anaerobic conditions, so that their molecules are decomposed into smaller ones.

### 7) Incineration

Incineration is a process of converting organic waste into a large amount of stable oxidized gases and a smaller amount of stable inorganic substances, by oxidizing them at high temperature in a gaseous atmosphere. It also reduces volume. In addition, the high temperature exhaust gases obtained from combustion provide thermal energy that can be collected as steam, heating water and electrical power from thermal generation by means of heat exchange. The accompanying flue gases have to be cleaned in an appropriate facility before discharge into the atmosphere.

### 8) Composting

Compost is a kind of fertilizer made from organic substances. Organic substances contained in waste and other raw materials are decomposed into carbon dioxide, water and heat as microbes activate metabolism (fermentation of organic materials) in the presence of water and oxygen (aerobic conditions). The energy required for microbes to live is supplied through the biological oxidation of carbon. Phosphoric acid, nitrogen, potassium in the form of K20 and other organic salts are produced at the same time from dead animals and vegetables as the final products of the metabolism. These products represent the fertilizing components contained in compost.

## 2.5.5 Existing Situation of Medical Waste

### 1) General

Medical establishments in Almaty city are categorized into four groups, managed respectively by, the City Health Care Department, the Oblast Health Care Department, the National Health Care Service and those establishments not belonging to the Ministry of Health but to a number of other ministries, such as the Ministry of Defense, etc. Fourteen hospitals and dispensaries belong to that group.

Twenty-six (26) hospitals and clinics are managed by the City Health Care Dept., 5 are the responsibility of the Oblast Health Care Dept. and 15 are managed within the National Heath Care Service scale and are under national management. All these medical establishments depend on the Ministry of Health. The Supporting Report lists the different hospitals and clinics according to their entities.

There are about 60 hospitals and 10 Sanatoriums with a total of 14,158 beds in the Almaty Greater Municipality. The so-called "polyclinics" in the region do not have beds for inpatient treatment. Each polyclinic (or medical center) is responsible for a certain area in the city with a certain population number. There are about 37 such polyclinics for a total population of 1.06 million persons.

### 2) Definition

Generally it is understood that medical waste is the waste generated in hospitals or medical establishments. In hospitals not only specific medical waste is generated but also household waste. It is essential, first of all, to define what is meant by "medical waste". There is not even an agreed definition that should. Various terms are being used more or less synonymously with medical waste including infectious waste, infective waste, bio-hazardous waste, medical hazardous waste, microbiological waste, pathological waste

and even "red bag" waste.

For the present study the term medical waste is used throughout to denote any waste generated in a medical establishment and shall differentiate between:

- The first type of medical waste being specific medical waste, contains infectious waste and shall be defined as any waste that is capable of causing infectious disease,
- The second type of waste is the household type waste generated in hospitals or medical establishments. It covers all types of non infectious and shall be defined as any waste generated in the kitchen and the administration areas of the hospital or medical establishment as far as it is not mixed (collected separately) with infectious waste.

The following waste generated in hospitals is classified and should be managed as infectious waste:

- Human blood and blood products
- Culture and stocks of infectious agents
- Pathological waste
- (Contaminated) sharps
- Contaminated laboratory waste
- Contaminated waste from patient care
- Discarded biologicals
- Contaminated animals carcasses and body parts
- Contaminated equipment
- Miscellaneous infectious waste

### 2.5.6 Survey on Hospital Waste

Within the set up of database all three Health Care Services (City, Oblast and National levels) have been approached to list existing medical establishments in the City of Almaty. Furthermore a survey of 10 hospitals including a questionnaire has been carried out. The results of this survey are presented in the Supporting Report.

According to the survey very few medical establishments have special departments responsible for SWM. None regularly record the quantities of waste generated.

Precautionary measures are taken only in discharging some liquid hospital waste by sterilizing it with chlorine solution prior to discharge into the sewage system.

Many discrepancies have been however noticed between the answers to the questionnaires, the official data received from the Heath Care Services and the information received during our visits. For example 2 Hospitals belonging to the City Health Care Service confirm having incinerators for infectious waste. The information held by the service concerned denies that any infectious waste is incinerated. The number of beds given officially for the City Hospital No 1 has been confirmed while different figures have been given during the visit to the hospital.

### 2.5.7 Quantity, Nature and Current Hospital Waste Management

The data base for waste quantities generated in the hospitals and clinics can only be based on the results gained from the survey as well as the data received from the Health Services. The results are presented in Chapter 7 of this report.

### 2.5.8 Treatment Methods for Hospital Specific Waste

Hospital specific waste (to be distinguished from the household waste part of hospital residues), being hazardous to the environment and to people because of its composition, has to be treated before its disposal. The most important treatment methods for hospital specific waste are:

- Steam sterilization of infectious waste
- Incineration of infectious waste

#### 1) Steam Sterilization of Infectious Waste

Steam sterilization requires that the infectious agents contained in the waste be exposed to a high temperature (110 – 135 °C) for sufficient duration (2 – 30 min.). Steam is used to destroy infectious agents contained in the waste. An Autoclave is the common type of steam sterilizer (see Figure 2.5.1). The chamber has an inlet for steam and outlet for steam, air and condensation.

Waste containers are placed on racks or load carriers and loaded into the autoclave. The autoclave is closed and steam enters the chamber. Preheating of the chamber and its contents reduces the warm up period and condensation of water inside the chamber and on the waste. Once waste is sterilized, it can be transported and disposed of at the municipal landfill site.

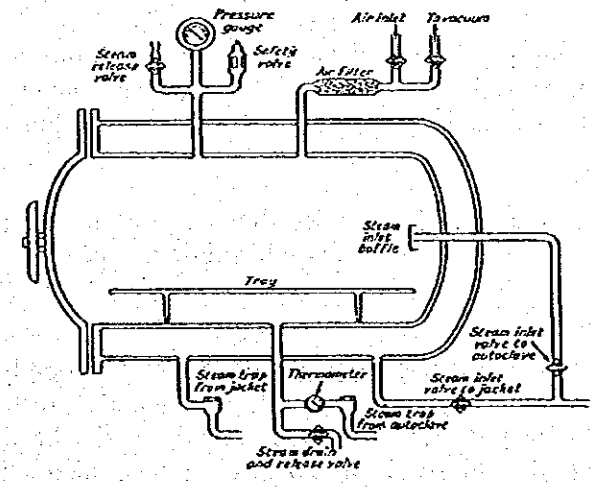


**Figure 2.5.1 Scheme of an Autoclave operating with Steam**

#### 2) Incineration of Infectious Waste

Incineration appears, in many ways, to be the ideal solution to waste management. An incinerator can destroying hazardous components and reduce volume leaving only ash to dispose of.

The physical components of an incinerator include a primary combustion chamber (into which waste is fed), a secondary combustion chamber (where gases which will be incinerated have volatized from the primary chamber) and a stack to vent combustion gas (see Figure 2.5.2).

An air pollution control system can be used to remove particulate and acid gases, which consists of scrubbers. A boiler may be added after the secondary combustion chamber and before the scrubber for heat recovering.

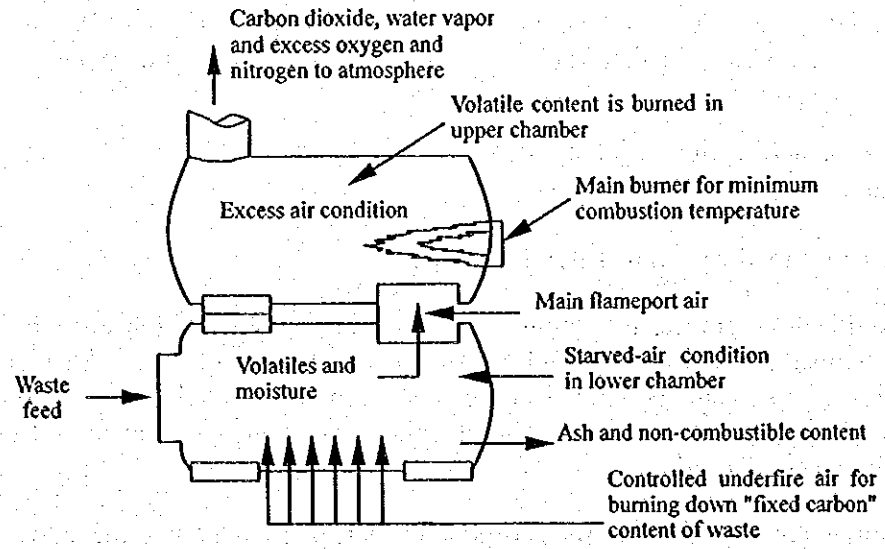


**Figure 2.5.2 Scheme of the Firing System for the Incineration**

### 2.5.9 General Recommendations for Medical and Industrial Waste Management

It is difficult to define any precise and detailed recommendations concerning industrial and medical waste after only six weeks of work, particularly when the data records over long periods are not available. Some general recommendations however can be mentioned.

Production lines and technological processes that generate industrial waste should be optimized and modified in such a way that would minimize the generated waste.

#### 1) Industrial Waste

Industrial waste definition and therefore classification do not comply with international definition standards. In order to have common definition and a greater harmonization of the management of industrial waste and particularly toxic waste, the Study team recommends referring to the industrial waste classification of international standards (i.e. the definition should list hazardous waste, constituents and properties, which render waste hazardous).

A high proportion of the city's industrial (and commercial) waste at present comes to the landfill site at Karasai where the collection companies are contracted to transport it. Here ACDEP has an excellent opportunity to monitor the nature and extent of the waste it is receiving. In addition, all industrial companies should systematically record their industrial waste, including recovered waste.

In this way a close relationship between production and waste generation can be established, and ACDEP can establish, control and monitor the extent of burdens and responsibilities it has to meet.

In order to reduce their industrial waste the different companies have to introduce a system of industrial waste separation at the source, if such a method of collection is not practiced, or to carry it out to such an extent as is possible. This can be achieved by placing a number of containers for different types of waste in the factories, for example for paper, carton, metal, glass, plastic, wood.

Existing recycling companies such as Kaztorchermet or Vtorzetmet should be preserved and strengthened as necessary.

The existing plastic recycling plant, designed for 2,000t/year, currently is not recycling plastics at all. This means that the required plastic recycling capacity is already available and should be used.

Unfortunately glass recycling does not exist in the Almaty region. Facilities for glass recycling should be promoted in the region (i.e. through involving private sector).

**2) Hospital Waste**

Solid waste management at medical establishments needs to improve.

Separation of infectious waste should be introduced in all hospitals and clinics in order to reduce the risks of any contamination (during collection, transport and at the landfill). Regulations should be issued and administered.

At a second stage, infectious waste should be treated and rendered harmless prior to disposal at the municipal landfill site.

## 2.6 EXISTING INSTITUTIONAL STRUCTURES

### 2.6.1 Structure of Communal Services under the Old Economic System

To understand the current structural problems, it is worthwhile taking a brief look at the changes that have already occurred over the past decade.

Under the previous economic system, nearly all economic activity was under the control of the Government. This was exercised through a vertical pyramid structure. Control over services such as solid waste removal was relatively easy. Once technical standards had been set to protect public health and the environment, resources could be directed to provide the services that the technical experts judged to be necessary. Practically, the question of the power of the akimate to require the population to use and pay for such services was not questioned. The only practical problem was identifying the appropriate level to which requests for resources should be referred. Identifying who should take responsibility for such services was not a major problem either. Such issues could always be resolved administratively.

The change in the economic management system has had far reaching impacts. Conversion to a market system has been seen to be primarily a matter of changing

ownership of economic entities from the state to private owners and relying on the market to set prices. While both of these steps are important, there are many other changes which are being induced by the ownership changes. These in turn demand some fundamental changes in the way that public services are managed.

The privatization of many forms of property has broken up the monolithic ownership structure in many areas, including housing. Now many independent owners are involved. The application of the underlying philosophy of market economics, namely the decentralization of decision making to use the knowledge and skills of the parties directly involved, may eventually see some delegation of power within the public sphere, though to date there has been little change.

In any event, relations amongst these independent owners can no longer continue to be controlled by purely administrative processes. In the new system these relationships must be managed through legal processes rather than through administrative actions. These changes are needed in many sectors of the economy, including housing, solid waste management and environmental protection.

To date there has been some progress in revising laws to establish public health and environmental standards, and in creating institutions to monitor and enforce these new laws. However there has been little or no progress towards developing a legal and institutional structure to manage these sectors, to clarify the powers and responsibilities and to manage the relationships amongst the new economic agents that have been created by the economic changes. The key structural gaps are identified in the following sections.

### 2.6.2 Responsibilities for Communal Services

The current responsibilities of different entities for communal services, in particular SWM, are unclear. Prior to the economic changes the akimate de facto took overall responsibility which it discharged through its Department of Housing and Communal Services. This exercised a supervisory role over the State Enterprise Housing and Communal Services which collected all waste in the city. This entity, being part of the unified government structure, could be managed to meet the public health and environmental objectives of the akimate and the Government. Now that this state enterprise has been broken up and "privatized" the old method of supervision is not appropriate. However in the absence of any alternatives, the akimate is trying to exercise its former supervisory role using informal methods.

In particular no one appears to have any responsibility to ensure that coverage of services is universal. The Charter of the current Department of Housing mentions "co-ordination"[1], but this leaves much scope for transferring responsibility to the next party. There are three types of gaps that have been opened by the change of ownership patterns for housing. Firstly there is no effective mechanism to ensure that someone enters a contract covering every area of the city. Secondly the boundary between common areas owned collectively by a group of private owners and public areas controlled directly by the Government is often unclear. Thirdly the responsibilities of private owners for common areas is unclear.

[1] It is possible that the word "co-ordination" has different connotations in Russian and in English and that this clause is stronger in the original Russian document than in its English translation. However judging from the lack of effectiveness of this clause this seems unlikely.

With the introduction of private ownership, the Government introduced a Housing Act which encourages the formation of co-operatives (KSKs and KSDs) to take responsibility for common areas and facilities. These provisions require considerable strengthening, to ensure that property owners' rights and responsibilities are clearly stated and to prevent individual owners avoiding their communal duties.

To clarify these responsibilities two major changes are needed.

Firstly some form of "Local Government Act" must be introduced which clearly specifies the powers and responsibilities of local levels of Government for land use planning, land use management, approval and condemning of any structures on such land and management of communal services.

Secondly the Land Title Acts and Housing Act need to be revised to force the creation of a legal entity which can be held responsible for the management of communal areas and services within land allotments and structures where discrete sub-areas are owned by different entities. Both issues are discussed at more length in the Supporting Report.

### 2.6.3 Akimate Financial Responsibilities

Currently the Akimate does not formally accept any responsibility for SWM. SWM is a Public responsibility. While all citizens should be required to accept and pay for the service through user charges, the city Government must accept ultimate responsibility for the financing of the sector.

A Waste Authority, on behalf of the akimate should accept responsibility for collection of user charges, perhaps integrating the collection process into the land tax system. A continuation of the present system where the charge is collected by the KSK's or the collection companies poses significant problems. As the collection companies are denied the usual commercial sanction of ceasing service if fees are not paid, they would need to be given extra-ordinary powers to collect fees; a move that the team would not recommend. In addition there would need to be substantial duplication of the accounting function of these collection companies, either in the akimate or some other Government body, to identify pensioners and other needy persons eligible for relief. It would certainly be more efficient for the akimate to calculate fees owed and identify residents receiving some form of relief in the one step. Note that the actual collection of money could be carried out by the Peoples Bank which would account for money received against a schedule supplied by the akimate or Waste Authority.

The Waste Authority should also be responsible for overall management. Waste collection companies could contract directly with the Waste Authority to provide collection services in specified areas. The Waste Authority should also own transfer station(s) and disposal site(s) contracting out the day to day management of these facilities.

Currently KSKs are responsible for containers and container platforms. There is a need to upgrade and increase the stock of containers and to improve maintenance of platforms. Responsibility for the platforms should remain with the KSK's but responsibility for and ownership of the containers should be transferred to the Waste Authority, which should become responsible for ensuring that sufficient containers are supplied to all sites. This will be a key reform to ensure universal coverage of collection services.