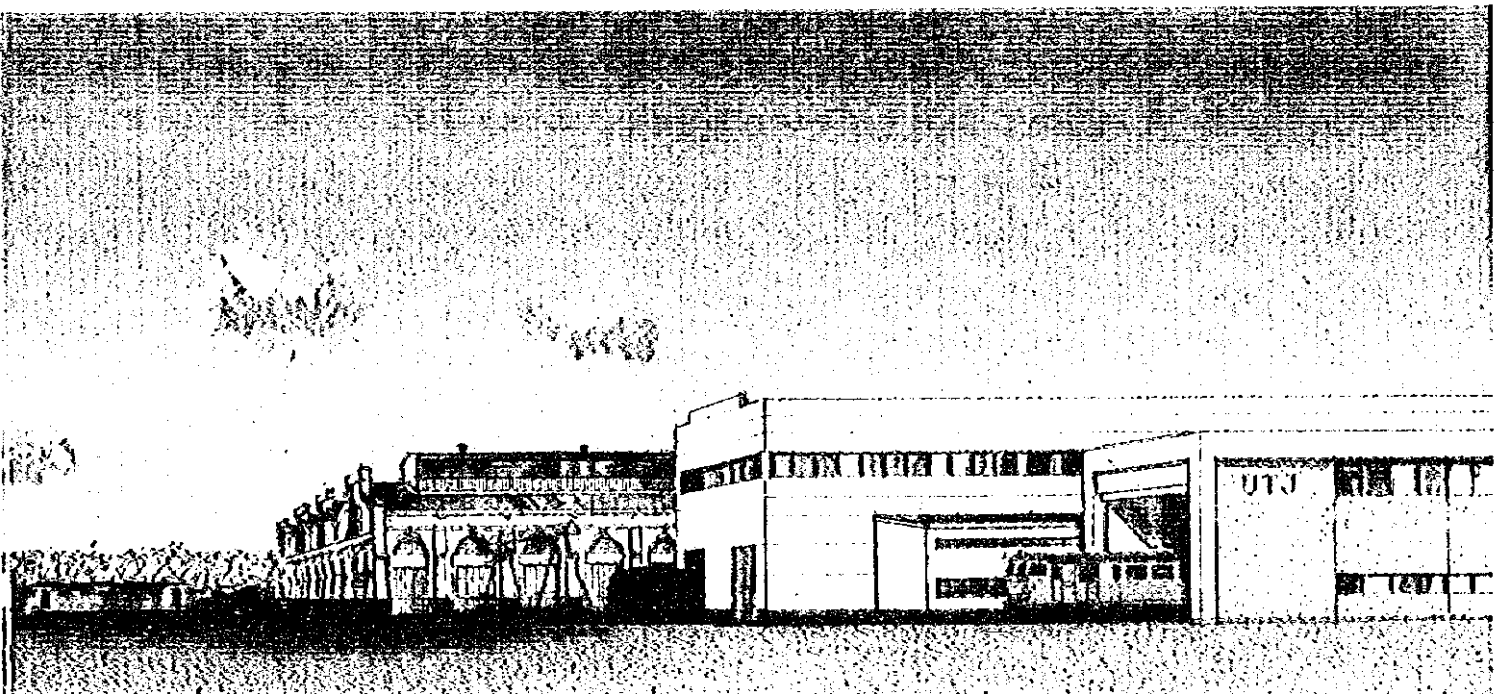
JAPAN INTERNATIONAL
COOPERATION AGENCY(JICA)

REPUBLC OF UZBEKISTAN

社会開発調査部報告書

THE FEASIBILITY STUDY
ON
THE CONSTRUCTION OF ELECTRIC LOCOMOTIVE REPAIR WORKSHOP
IN
UZBEKISTAN

FINAL REPORT
APPENDIX



JULY 1997

JAPAN RAILWAY TECHINICAL SERVISE
JAPAN TRANSPORTATION CONSULTANS,INC.
PACIFIC CONSULTANTS INTERNATIONAL

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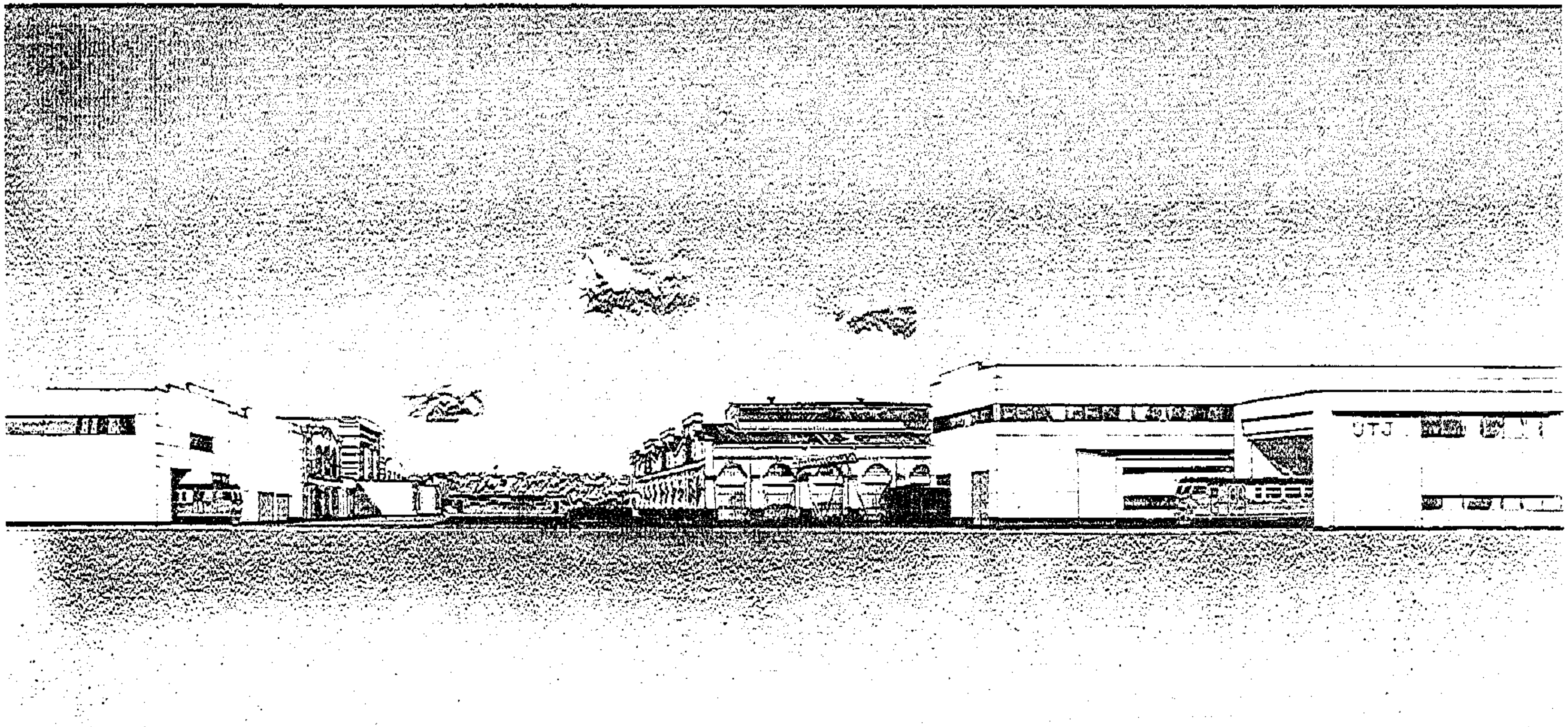

ELECTRIC LOCOMOTIVE REPAIR WORKSHOP

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Appendix 1 Scope of Work for The Feasibility Study on the Construction of Electric Locomotive Repair Workshop in Uzbekistan Agreed Upon Between Uzbekisatn Raiways and Japan International Cooperation Agency

SCOPE OF WORK

FOR

THE FEASIBILITY STUDY

ON

THE CONSTRUCTION OF ELECTRIC LOCOMOTIVE REPAIR WORKSHOP

IN

UZBEKISTAN

AGREED UPON BETWEEN

UZBEKISTAN RAILWAYS

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Tashkent , July 18 , 1996

Mr. Mikhail Z. MARTYANOV
Vice Chairman
Uzbekistan Railways

山下廣行

Mr. Hiroyuki YAMASHITA
Leader
Preparatory Study Team
Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of the Government of Uzbekistan, the Government of Japan decided to conduct the Feasibility Study on the Construction of Electric Locomotive Repair Workshop in Uzbekistan (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Uzbekistan.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the study for the project are to organise the base for repair workshop, to conduct a feasibility study on the construction of electric locomotive repair workshop in Uzbekistan.

III. STUDY AREA

The study area to be covered is Uzbekistan depot and Tashkent Repair Workshop, Tashkent Region

IV. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover the following items;

1. Evaluation of the present conditions

(1) Collection, and analysis of relevant reports, data, and information

(2) Survey of social and economic conditions

(3) Examination of present condition on Uzbekistan Railways (hereinafter referred to as " UTJ ")

1) railway facilities

2) railway network and train operation conditions

3) repair workshops

4) repair and inspection system for electric locomotive and electric railcar

(4) Review of the electrification plan

2. Demand forecast (Target year 2010)

(1) Projection of socio-economic framework

(2) Forecast of transportation demand (all mode)

(3) Estimation of the railway traffic volume by passenger and freight

3. Initial Environmental Examination (IEE)

4. Basic concept of the future plans for repair shops

5. Undertaking of a feasibility study

(1) Survey on natural conditions

(2) Survey on present environmental conditions

(3) Estimation of the number of electric locomotives and electric railcars in the future

(4) Formulation of repair and inspection systems for electric locomotives and electric railcars

(5) Preliminary engineering design

1) optimum location of the repair workshop
2) scale and layout of the repair workshop
3) number and kind of the facilities and equipment
4) principle technical specification of the facilities and equipment

(6) Preliminary cost estimation

(7) Evaluation of the site of the repair workshop

(8) Formulation of an operation and maintenance program

(9) Formulation of an implementation program

(10) Project evaluation

1) economic evaluation
2) financial evaluation
3) environmental impact assessment (EIA)

6. Overall evaluation and recommendation

V. STUDY SCHEDULE

The Study shall be conducted in accordance with the attached tentative schedule.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Uzbekistan.

1. Inception Report

   Twenty (20) copies
   At the commencement of the Study

2. Progress Report

   Twenty (20) copies
   Within two (2) months after the commencement of the Study

3. Draft Final Report

   Twenty (20) copies
   Within six (6) months after the commencement of the Study
   The written comments on the Draft Final Report from the Government of Uzbekistan shall be delivered to JICA within one (1) month after submission of the report.

4. Final Report

   Forty (40) copies
   Within two (2) months after the receipt of the written comments on the Draft Final Report from the Government of Uzbekistan.

VII. UNDERTAKING OF THE GOVERNMENT OF UZBEKISTAN

1. To facilitate smooth conduct of the Study, the Government of Uzbekistan shall take necessary measures ;

(1) To secure the safety of the Japanese study team (hereinafter referred to as " the Team ")

(2) To permit the members of the Team to enter, leave and sojourn in Uzbekistan for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,

(3) To exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into and out of Uzbekistan for the conduct of the Study,

(4) To exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study,

(5) To provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Uzbekistan from Japan in connection with the implementation of the Study,

(6) To secure permission for entry into private properties or restricted areas for the implementation of the Study,

(7) To secure permission for the Team to take all data and documents including maps and photographs related to the Study out of Uzbekistan to Japan,

(8) To provide medical services as needed. Its expenses will be chargeable on members of the Team.

2. The Government of Uzbekistan shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

3. UTJ shall act as counterpart agency to the Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. UTJ shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned :

(1) Available data and information related to the Study,

(2) Counterpart personnel,

(3) Suitable office space with necessary office equipment in Tashkent and the study area, if necessary,

(4) Credentials of identification cards,

(5) Appropriate number of vehicles with drivers.

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures :

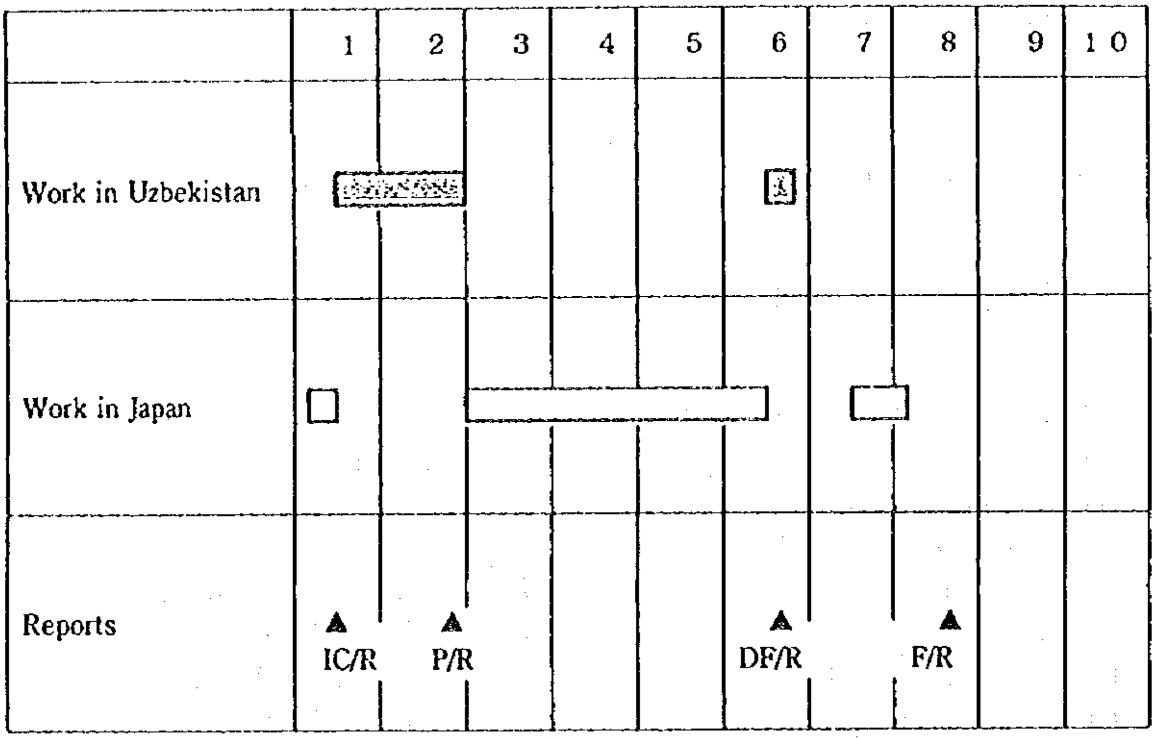
1. To dispatch, at its own expense, the Team to Uzbekistan,

2. To pursue technology transfer to the Uzbekistan counterpart personnel in the course of the Study.

IX. OTHERS

JICA and UTJ shall consult with each other in respect of any matter that may arise from or in connection with the Study.

TENTATIVE SCHEDULE OF THE STUDY



IC/R : Inception Report

P/R : Progress Report

DF/R : Draft Final Report

F/R : Final Report

Appendix 5-1 Data on Natural and Environmental Condition of Uzbekistan

Fig.1 Oblasts (States) of Uzbekistan

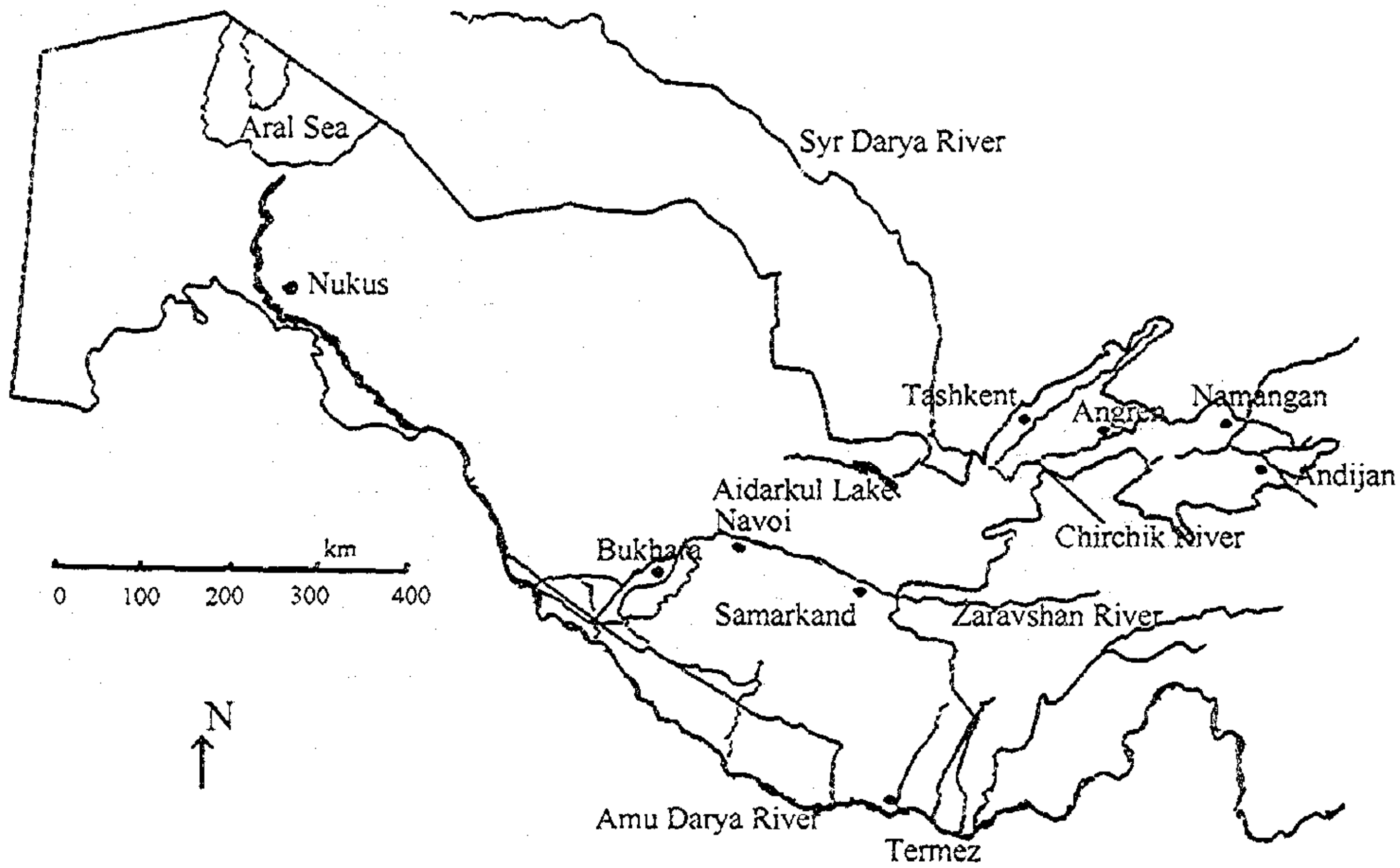


Fig.2 Major River and Lakes of Uzbekistan

Table 1 Groundwater Resources and Usage in Uzbekistan in 1994

Oblast	Approved reserves	Groundwater use for					Extraction as a percentage of approved reserves (%)
		Drinking water	Industrial supply	Irrigation water	Pastures	Total	
	(thousands of m^3)						
Andijan	1,687	756	–	3	–	758	45
Namangan	3,541	323	–	1,714	–	2,037	58
Fergana	5,183	418	354	1,815	–	2,587	50
	1,719	545	17	15	–	577	34
Bukhara	374	54	–	2	13	69	18
Navoi	1,050	27	15	215	50	307	29
Tashkent	3,675	1,225	190	7	–	1,422	39
Djizak	708	240	–	–	–	240	34
Syrdarya	531	81	–	–	–	81	15
Surkhandarya	602	146	–	–	–	146	24
Kashkadarya	597	247	1	94	1	343	57
Khorezm	337	11	–	–	–	11	3
Karakalpakstan	526	33	–	2	77	112	21
Total	20,530	4,106	577	3,867	141	8,690	42

(Source: State Committee for Nature Protection (through DAI))

Table 2 Water Quality Standards in Uzbekistan

Items	Unit	Maximum Permissible Concentration	
		fisheries	drinking water supply
BOD_5	mg O/l	3	6
COD	mg O/l	30	30
pH		6.5 to 8.5	6.5 to 8.5
Oil products	mg/l	0.05	0.3
Phenol	mg/l	0.001	0.001
Cadmium	mg/l	0.005	0.01
Iron	mg/l	0.5	0.5
Copper	mg/l	0.01	1
Nickel	mg/l	0.01	0.1
Tin	mg/l	0.03	0.1
Chromium	mg/l	0.001	0.1
Zinc	mg/l	0.01	1
Arsenic	mg/l	0.05	0.5
Mercury	mg/l	0.005	0.005
Cyanide	mg/l	0.05	0.1
Ammonium Nitrogen	mg N/l	0.39	2
Nitrite Nitrogen	mg N/l	0.08	0.08
Nitrate Nitrogen	mg N/l	0.1	10
Chlorine	mg/l	none	1.5
Detergents (Synthetic Surfactant)	mg/l	0.1	0.5

(Source: State Committee for Nature Protection (through DAI))

Table 3 Water Quality Standard for Discharge to Municipal Sewage Treatment System in Uzbekistan

Items	Unit	Maximum Permissible Concentration discharge to sewerage treatment
BOD_5	mg O/l	500
COD	mg O/l	500
pH		6 to 9
Oil products	mg/l	5
Phenol	mg/l	5
Cadmium	mg/l	5
Iron	mg/l	5
Copper	mg/l	0.5
Nickel	mg/l	0.5
Tin	mg/l	0.5
Chromium	mg/l	0.1
Zinc	mg/l	1
Arsenic	mg/l	0.1
Mercury	mg/l	0.1
Cyanide	mg/l	–
Ammonium Nitrogen	mg N/l	100
Nitrite Nitrogen	mg N/l	100
Nitrate Nitrogen	mg N/l	100
Chlorine	mg/l	–
Detergents (Synthetic Surfactant)	mg/l	–

(Source: State Committee for Nature Protection (through DAI))

Table 4 Limited Permissible Concentration (LPC) on the Air Quality in the Former USSR

Substance	Limited Permissible Concentration (LPC), mg/m^3	
	Onetime Maximum	Daily Average
Carbon monoxide	5	3
Nitrogen dioxide	0.085	0.04
Ozone	0.16	0.03
Particulate matter	0.5	0.15
Form aldehyde	0.035	0.003

(Source: Item of the USSR decree on the atmospheric air protection (approved 22nd August, 1984))

Table 5 Potable Water Supply in Uzbekistan.

	Karakalpakstan	Tashkent City	Tashkent without Tashkent City	Uzbekistan total
Capacity 1000m^3				
-1975	70	1,341	355	2,643
-1980	80	1,841	433	3,781
-1985	135	2,041	570	5,034
-1990	202	2,240	819	6,797
Coverage % of population				
-1975	64	82	74	74
-1980	63	86	80	77
-1985	65	90	85	80
-1990	67	94	86	84
Consumption lit/day/person				
-1975	128	500	370	310
-1980	152	620	470	370
-1985	162	718	477	383
-1990	254	750	499	470

(Source: State Committee for Nature Protection (through DAI))

Table 6 Highly Polluted River in Tashkent Oblast

Water source/river	Pollution source	Pollutants
Chirchik River	Chirchikselmash Plant	oil products
	Chirchik electric motors plant	nitrogen compounds, oil products
	JV "Kaprolaktam"	caprolactam
	Chirchik Vodokanal	nitrogen compounds, oil products, phosphates
	Tashvodocanal	nitrogen compounds, metals, BOD, phosphates
	Excavator plant	oil products
	Tashkent aircraft plant	chromium
	Kurganchyisky plant	nitrogen compounds, BOD
	Novomihaylovsky	nitrogen compounds, BOD, phosphates
	Sergrly agro-industrial complex	nitrogen compounds, BOD, phosphates
	Uzbekistan poultry factory	nitrogen compounds, BOD, phosphates
	Chinaz fish fodder plant	nitrogen compounds, BOD
	Sergely reinforced concrete structured plant	oil products, iron, suspended solids
	collector drains from irrigated lands	salts, pesticides, metals
Karasu (right bank)	Tashkent tractor plant	oil products
Salar Canal and then the Chirchik River	Almazar car repair plant #5	oil products, chromium, nonmetals
	Aircraft factory	oil products
	Yangiul biochemical plant	nitrogen compounds, BOD, phosphates
Bozsu Canal and then Syr Darya River	Tashkent electrical power generation station	thermal pollution, oil products
	Aircraft factory	chromium, copper, oil products
	Taxi park #7	oil products
	Bus park #4	oil products
	Tashkent Railways	oil products
	Yangiul pig-breeding complex	nitrogen compounds, BOD, phosphates
	Yangiul poultry factory	nitrogen compounds, BOD, phosphates
	Tashvodocanal	nitrogen compounds, metal, BOD, phosphates
Ahangaran River	Yangiabad mine administration #2	nitrogen compounds, BOD, phosphates
	Uaylipsky plant	nitrogen compounds, BOD, phosphates
	Angren ceramic plant	oil products
	Namangan Vodocanal	metal
	Kokand Vodocanal	nitrogen compounds, BOD, phosphates
	Fergana Vodocanal	nitrogen compounds, BOD, phosphates
	Rishtan Vodocanal	nitrogen compounds, BOD, phosphates
	Kokand superphosphate plant	oil products, phenols, nitrogen compounds
	"Rustam" Kokand	nitrogen compounds, oil products
	Fergana train park, Kokand	oil products
	Kokand fat factory	fats

(Source: State Committee for Nature Protection (through DAI))

Table 7 Locations of Highly polluted Groundwater in Tashkent Oblast

River basin/location	pollution source	pollutants
Chirchik Valley, and Kibray and other water intake	Electrohimprom railway poultry factory quarries of non-ore materials Interrayon sewage water collector	nitrogen compounds
Akhangran Valley	Akhangran mining and metallurgic plant waste dumps	mineral salts sulfates phosphates cadmium selenium
Aquifers between the Chirchik and Akhangran Rivers	livestock breeding poultry factories Jute-kenaf plants improper disposal of chemicals and fertilizers dumps of industrial and domestic waste	mineral salts sulfates phosphates cadmium selenium nitrogen compounds

(Source: State Committee for Nature Protection (through DAI))

Table 8 Number of Enterprises Generation More than 100,000 m^3 of Wastewater per Year

oblast	number of enterprises, by type A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total
Fergana	1	2	3	0	2	4	5	0	5	4	3	7	1	0	0	0	37
Tashkent	1	17	13	10	12	11	21	13	2	4	1	0	4	3	3	9	124
Karakalpakstan	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
Uzbekistan total	11	37	24	11	19	49	46	18	11	11	8	9	8	4	4	11	281

type of enterprises

A	textile industry	I	petroleum processing
B	construction industry	J	chemical industry
C	transportation industry	K	medical services industry
D	nonferrous metals industry	L	cotton processing
E	mining	M	energy production
F	food processing industry	N	fisheries
G	municipal wastewater treatment plants	O	furniture production
H	machine building/metal working industry	P	lubricant production

(Source: State Committee for Nature Protection (through DAI))

Table 9 Capacity and Coverage of Wastewater Treatment Facilities in Uzbekistan

	Capacity, 1,000 m^3 /day				Coverage, % of population served			
	1975	1980	1985	1990	1975	1980	1985	1990
Karakalpakstan	0	0	0	6	0	0	0	10
Tashkent City	902	1,170	1,370	1,670	60	65	70	80
Tashkent without Tashkent City	210	330	450	495	29	39	42	46
Fergana	160	210	210	319	17	23	26	37
Uzbekistan total	1,516	2,110	2,690	3,494	26	29	33	40

(Source: State Committee for Nature Protection)

Table 10 Fines for Discharge of Pollutants in Uzbekistan

Wastewater Discharge	
pollutant	rate, sum/ton
ammonium nitrogen	1,024
nitrite nitrogen	20,000
nitrate nitrogen	44
acetone	8,000
benzene	800
cadmium	80,000
cobalt	40,000
arsenic	8,000
oil products	80,000
nickel	40,000
sulfates	4
lead	13,320
phenols	400,000
fluoride	8,000
chloride	1.2
zinc	40,000
cyanide	8,000

(Source: State Committee for Nature Protection (through DAI))

Table 11 Fossil Fuel Reserves in Uzbekistan

Energy resource	Reserved quantity	Production levels
natural gas	2 trillion m^3	47 billion m^3 in 1994 almost 50 billion m^3 in 1995 (total production is forecast to rise to 60 billion m^3 per year by 2000)
coal	2 billion tons	3.8 million tons in 1993
petroleum	300 million tons	5.5 million tons in 1994 almost 8 million tons in 1995 (total production is forecast to rise to 9 million tons per year by 2010)

Sources: Economy of Uzbekistan (National Bank for Foreign Economic Activity of the Republic Uzbekistan, 1993) and Uzbekistan Profile (for presentation at the 1996 EBRD Annual Meeting) (through DAI)

Table 12 Aggregate Air Pollutant Emission in Uzbekistan

Place	Year	Emissions of air pollutants, thousands of tons					
		Particulate	sulfur oxide	carbon monoxide	nitrogen oxide	hydrocarbons	total
Tashkent City	1990	11.2	1.5	15.3	4.8	6.2	39.4
	1991	9.2	1.3	13.8	4.8	5.2	34.6
	1992	4.5	0.9	8.9	4.9	3.8	23.2
	1993	3.3	0.8	9.3	4.7	3.2	21.4
	1994	2.9	0.8	7.8	3.0	2.7	18.2
	1995	2.1	0.6	7.1	3.7	0.9	15.0
Tashkent Oblast	1990	83.7	272.4	38.8	43.2	4.4	447.2
	1991	80.6	256.5	41.9	41.5	10.6	436.0
	1992	75.3	234.1	41.5	36.9	6.6	396.9
	1993	75.3	190.6	29.7	32.3	4.9	335.2
	1994	64.0	161.8	24.1	30.7	3.8	285.9
	1995	65.9	167.7	18.2	27.3	4.5	286.6
Uzbekistan	1990	252.1	541.6	129.6	117.1	215.2	1,277.1
	1991	224.9	499.9	143.9	111.7	213.2	1,214.8
	1992	203.3	455.2	159.1	100.0	175.8	1,107.8
	1993	178.1	442.2	136.3	92.9	163.2	1,020.8
	1994	147.1	376.7	152.7	148.4	97.0	928.7
	1995	127.0	399.9	147.5	78.3	141.8	901.7

(Source: State Committee for Nature Protection (through DAI))

Table 13 Mean Annual Concentration of Air Pollutants for Tashkent City

Pollutant	mean annual concentration of air pollutants (concentration is given as a multiple of MPC)				
	1991	1992	1993	1994	1995
particulate	1.3	1	1	1.3	1.7
SO_2	0.2	0.2	0.2	0.2	0.2
hydrocarbons	1	1.1	0.7	1	0.9
NO_2	2	1.5	1.3	1.5	1.3
NO	1.2	0.5	0.5	0.5	0.5
ammonium	1.2	1	1	0.8	0.8
Pb	0.6	0.5	0.6	0	0

(Source: State Committee for Nature Protection (through DAI))

Appendix 5-2 Data on the Environmental Condition of Tashkent Workshop

Table 1 Water Consumption in Tashkent Workshop

	Allowed 100% Capacity		Actual	
	m^3/day	1000 m^3/year	m^3/day	1000 m^3/year
Water Intake total	5459	1247	3789	1031
surface water	0	0	0	0
groundwater	4892	1094	3553	945
city water supply system	567	153	236	86
Water Consumption	5459	1247	3789	1031
domestic	567	153	236	86
(from groundwater)	0	0	0	0
industrial	4892	1094	3553	945
(from groundwater)	4892	1094	3553	945

(Source: Tashkent Workshop)

Table 2 Water Consumption (allowed 100% capacity) by section in Tashkent Workshop

Section		units	number of units	operating period (h/day)	operating days/year	Recycling systems		Water Consumption		
						m³/day	1000 m³/year	average l/day	m³/day	1000 m³/year
Industrial Needs						5135	1386.2		4892	1094
1.	power plant room									
	(winter period)				151				1038	156.7
	(summer period)				154				611	94.1
2.	boilers			24	151				409.8	61.9
3.	washing machines			15.6	266				579	154
			5	7.8	266				6.4	1.7
4.	cooling machines			15.6	294				1020	299.6
5.	cooling cupola		3	16	266	52	13.8		118.3	31.6
6.	cooling compressors				266	1024	272.4		635.4	169.1
7.	water-cooling tower					4059	1100		414	110
8.	distillation apparatus			7.8	266				11.4	3
9.	transport								42.9	11.4
10.	watering									
	(green area)	m^2	1250		180			3	3.8	0.7
	(concrete)	m^2	9500		180			0.4	3.8	0.7
	(sanitary zone)	m^2	10000		180			0.4	4	0.7
11.	fire-fighting									0.5
Domestic Needs								1590	567	153
1.	canteen	person	2000	?	266			12	194.4	52
2.	laundry		1000		266			75	75	20
3.	administration	person	414	7.8	266			12	4.9	1.3
4.	goods shop	place	2	7.8	266			12	0.024	0.006
5.	food stuffs shop	place	1	7.8	266			250	0.25	0.07
6.	club	place	1	7.8	266			8.6	0.009	0.002
7.	gymnasium	person	40	15	365			50	2	0.73
8.	pool	person	20	15	365			100	2.04	0.74
9.	shower									
	(I shift)	set	300	7.8	266			500	150	40
	(II shift)	set	150	7.8	266			500	75	20
10	welfare center									
	(I)	person	635	15.6	266			45	28.6	8
	(II)	person	1403	15.6	266			25	36.1	10
Total									5453	1247

(Source: Tashkent Workshop)

Table 3 Wastewater discharge (allowed 100% capacity) by section in Tashkent Workshop

Section		units	number of units	operating period (h/day)	operating days/year	wastewater discharge average l/day	wastewater discharge m³/day	wastewater discharge 1000 m³/year	disposal place
Industrial Needs							3170	784.2	
1.	power plant room								
	(winter period)				151		222	33.5	municipal treatment plant
	(summer period)				154		131	20.2	municipal treatment plant
2.	boilers			24	151		409.8	61.9	municipal treatment plant
3.	washing machines			15.6	266		579	154	treatment facility
			5	7.8	266		6.4	1.7	treatment facility
4.	cooling machines			15.6	294		1020	299.6	municipal treatment plant
5.	cooling cupola		3	16	266		118.3	31.6	municipal treatment plant
6.	cooling compressors				266		635.4	169.1	municipal treatment plant
7.	water-cooling tower								
8.	distillation apparatus			7.8	266		11.4	3	municipal treatment plant
9.	transport						42.4	11.3	municipal treatment plant
10.	watering								
	(green area)	m^2	1250		180				
	(concrete)	m^2	9500		180				
	(sanitary zone)	m^2	10000		180				
11.	fire-fighting								
Domestic Needs						1590	567	153	
1.	canteen	person	2000	?	266	12	194.4	52	municipal treatment plant
2.	laundry		1000		266	75	75	20	municipal treatment plant
3.	administration	person	414	7.8	266	12	4.9	1.3	municipal treatment plant
4.	goods shop	place	2	7.8	266	12	0.024	0.006	municipal treatment plant
5.	food stuffs shop	place	1	7.8	266	250	0.25	0.07	municipal treatment plant
6.	club	place	1	7.8	266	8.6	0.009	0.002	municipal treatment plant
7.	gymnasium	person	40	15	365	50	2	0.73	municipal treatment plant
8.	pool	person	20	15	365	100	2.04	0.74	municipal treatment plant
9.	shower								
	(I shift)	set	300	7.8	266	500	150	40	municipal treatment plant
	(II shift)	set	150	7.8	266	500	75	20	municipal treatment plant
10	welfare center								
	(I)	person	635	15.6	266	45	28.6	8	municipal treatment plant
	(II)	person	1403	15.6	266	25	36.1	10	municipal treatment plant
Total							3737	937.2	

(Source: Tashkent Workshop)

Table 4 Emission into Air in Tashkent Workshop

Pollutant	1993(actual)		2000(prospect)		2005 (suggested allowable)	
	g/sec	tons/year	g/sec	tons/year	g/sec	tons/year
Total	244.025252	2728.30628	98.1352124	355.274702	78.7038526	214.104341
Solid (total)	28.910834	224.550442	6.1058724	31.8857376	6.8276646	41.904135
Alminum oxide	0.013	0.036	0.0013	0.0039	0.0063	0.0179
Aerosol (paint)	0.033	0.21	0.0309	0.327	0.0443	0.334
Aerosol (welding)	0.152	1.312	0.038	0.215	0.0425	0.233
Suspended solids	24.723	214.368	5.267	28.384	4.336	22.47
Ferric oxide	0.152	1.312	0.0629	0.49	1.061	3.183
Manganese dioxide	0.0046	0.0229	0.00467	0.0227	0.0361	0.875
Magnesium oxide	-	-	-	-	0.0499	0.475
Cupric oxide	0.0132	0.0329	0.0065	0.0268	0.0225	0.0458
Tin sulfate	-	-	-	-	0.00028	0.0008
Tin chloride	-	-	0.0000033	0.0000125	0.0000066	0.000021
Wood dust	0.395	1.31	0.432	1.432	0.432	1.432
Ash (organic dust)	3.374	5.711	0.2119	0.7481	0.0832	0.104
Lead	0.000358	0.000141	0.0000283	0.0000122	0.00021	0.000034
Dust with SiO_2<70%	0.000195	0.0012	0.000178	0.001087	0.565	10.67
Badly dissolved fluoride	0.000165	0.00126	-	-	0.0001	0.0016
Chrome (VI)	0.000016	0.000041	0.0000148	0.0001459	0.0031	0.0384
Cotton glass dust	0.0503	0.233	0.0503	0.2339	0.0503	0.233
Dust with 20%< SiO_2<70%	-	-	0.000178	0.00108	0.000368	0.00158
Calcium oxide	-	-	-	-	0.0945	1.789
Liquid and gas (total)	215.114418	2503.75584	92.02934	323.388964	71.876188	172.200206
Nitrogen dioxide	30.02	99.94	2.338	6.975	2.338	0.975
Nitrogen oxide	1.505	8.173	1.511	8.216	1.439	8.368
Ammonia	0.0048	0.011	0.00568	0.0122	0.00612	0.0128
Sulfur anhydride	1.885	14.918	44.161	37.113	43.694	29.251
Acetone	0.8119	4.115	0.434	3.44	0.424	3.403
Benzopyrene	0.000316	0.00034	0.000014	0.0000042	0.00002	0.000006
Petrol	1.456	20.244	1.456	20.244	0.92	11.979
Benzene	0.00609	0.192	0.0877	1.41	0.0877	1.41
Butyl acetate	0.12	1.383	0.217	1.83	0.2038	1.777
HCl	0.00315	0.0094	0.000372	0.0017	0.0043	0.038
HNO_3	-	-	0.00468	0.014	0.0047	0.014
H_2SO_4	0.004252	0.0276	0.0078	0.0435	0.002	0.016
Kerosine	-	-	0.084	0.314	0.192	0.71
Acetic acid	-	-	0.0012	0.0022	0.00181	0.00516
Xylene	0.534	5.29	0.687	7.0297	0.678	7.175
Grease steam	-	-	0.000056	0.00016	0.075	0.429
Sodium carbonate	0.0089	0.041	0.0482	0.0328	0.0539	0.564
Nickel (dissolved salts)	-	-	0.0016	0.0008	0.00013	0.0016
Hydrogen sulfide	0.00131	0.0412	0.0013	0.0441	0.0013	0.044
Ethyl alcohol	0.229	1.289	-	-	0.00157	0.00224
Solvent	0.0976	1.268	0.263	2.87	1.211	10.74
Toluene	0.414	2.826	0.374	3.403	0.308	3.139
Sodium triphosphate	-	-	0.0191	0.0367	0.166	0.257
Carbon monoxide	175.0537	2308.86	37.892	211.036	17.721	70.413
Phenol	0.0017	0.0518	0.0017	0.0518	0.0017	0.0518
Hydrocarbon	1.487	20.077	0.0635	0.418	-	-
Formaldehyde	0.013	0.026	0.0134	0.0267	0.0134	0.026
HF	0.0005	0.0029	0.000448	0.0024	0.000448	0.0024
Cyanide	-	-	0.00059	0.0042	0.00059	0.0042
Ethyl acetate	0.0006	0.0698	0.0001	0.012	0.0001	0.012
Ethyl cellosolbe	0.259	3.975	0.2938	5.93	0.283	5.89
White spirit	0.936	9.102	1.642	10.612	1.639	11.443
Butanol	0.07	0.736	0.07	0.736	0.0565	0.683
Ethanol	0.183	1.047	0.183	1.047	0.163	0.968
Sodium hydroxide	0.0086	0.0398	0.0121	0.179	0.0311	2.155
Tetrachloroethylene	-	-	0.014	0.151	0.014	0.151
Vanadium pentoxide	-	-	0.14	0.09	0.14	0.09

(Source: Tashkent Workshop)

Table 5 (1/3) Pollutant emissions parameters for Diesel Locomotive Building in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Emission	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	pollutants	g/s	ton/year
Washing	Washing machine	1	1570	Stack	266	15	0.6	0.8	0.56	41	Sodium hydroxide	0.000023	0.00013
											Benzine	0.0019	0.013
Repair Complex	Engine washing unit	1	2777	Stack	291	15	0.4	4.43	0.56	41	Suspended materials	0.0018	0.018
											Sodium hydroxide	0.00000094	0.0000077
											Benzine	0.014	0.179
	Heater	1	2018	Stack	292	8	0.6	3.6	1.02	150	Carbon monoxide	0.355	2.58
											Nitrogen oxides	0.0592	0.43
Painting	Medium	1	4149	Stack	299	15	0.5	5.5	4.3	24	Xylene	0.0322	0.481
											White-spirit	0.1162	1.733
											Solvent	0.0167	0.2496
											Toluene	0.0024	0.55814
											Paint aerosol	0.0075	0.106
											Benzene	0.0375	0.559
	Medium	1	3976	Stack	300	15	0.5	5.5	4.3	24	Xylene	0.0322	0.461
											White-spirit	0.1162	1.73
											Solvent	0.0167	0.2496
											Toluene	0.0024	0.0364
											Paint aerosol	0.0251	0.375
											Benzene	0.0054	0.0805
											Acetone	0.0787	1.173
	Medium	1	4149	Stack	301	15	0.5	5.5	4.3	24	Xylene	0.0322	0.481
											White-spirit	0.1162	1.733
											Solvent	0.0167	0.2496
											Toluene	0.0024	0.0364
											Benzene	0.01	0.1495
	Medium	1	4149	Stack	302	15	0.5	5.5	4.3	24	Xylene	0.0322	0.481
											White-spirit	0.1162	1.733
											Solvent	0.0167	0.2496
											Toluene	0.0024	0.0364
											Benzene	0.009	0.1352
P K Ц	Welding	1	1388	Stack	303	10	0.3	10.4	0.74	30	Oxide of iron	0.0024	0.012
											Oxide of manganese	0.00001	0.00005
Diesel	Bath	1	1867	Stack	322	15	0.6	2.9	0.82	30	Suspended materials	0.0029	0.0195
											Benzine	0.007	0.038
	Grinding	1	859	Stack	323	12	0.35	7.1	0.68	30	Suspension	0.0042	0.013
	Painting-drying room	1	2177	Stack	324	15	0.9	1.4	2.8	29	Xylene	0.00689	0.054
											White-spirit	0.05208	0.462
											Acetone	0.00582	0.0456
											Benzine	0.05	0.254
											Paint aerosol	0.0035	0.02389
	Painting-drying room	1	2177	Stack	325	15	0.9	3.5	2.23	29	Xylene	0.00689	0.054
											White-spirit	0.05208	0.462
											Acetone	0.00582	0.0456
											Benzine	0.04	0.1566
											Paint aerosol	0.0034	0.04261
	Diesel testing-stand	1	2083	Stack	326	18	0.9	3.1	2.2	30	Soot	0.0008	0.006
											Carbon monoxide	0.0264	0.159
											Nitrogen oxides	0.006	0.035

(Source: Tashkent Workshop)

Table 5 (2/3) Pollutant emissions parameters for Diesel Locomotive Building in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Emission	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	pollutants	g/s	ton/year
Diesel	Diesel testing-stand	1	2083	Stack	327	18	0.9	3.1	2.2	30	Soot	0.0008	0.006
											Carbon monoxide	0.0264	0.159
											Nitrogen oxides	0.006	0.035
	Diesel testing-stand	1	2083	Stack	328	18	0.9	3.1	2.2	30	Soot	0.0008	0.006
											Carbon monoxide	0.0264	0.159
											Nitrogen oxides	0.006	0.035
	Diesel testing-stand	1	2083	Stack	329	18	0.9	3.1	2.2	30	Soot	0.0008	0.006
											Carbon monoxide	0.0264	0.159
											Nitrogen oxides	0.006	0.035
	Sprayer stand	1	1851	Stack	334	12	0.4	4.2	0.53	27	Suspended materials	0.0024	0.016
											Benzine	0.023	0.348
	Washing for parts	1	1873	Stack	336	15	0.4	3.3	0.41	21	Suspended materials	0.00086	0.0058
											Benzine	0.0011	0.0039
	Argon welding	1	788	Stack	337	8	0.3	4.7	0.33	34	Oxide of iron	0.0032	0.0092
											Aluminum oxide	0.0013	0.0039
	Preparing paint	1	1784	Stack	338	8	0.3	5.5	0.39	20	Xylene	0.0175	0.1124
											Acetone	0.042	0.2851
											Toluene	0.0105	0.0653
	Examination stand	1	1405	Stack	339	11	0.4	2.3	0.29	30	Benzine	0.013	0.0658
	Welding post	1	1543	Stack	340	15	0.4	3.3	0.41	25	Oxide of iron	0.0018	0.01
											Oxide of manganese	0.000006	0.000029
	Medium	1	3386	Stack	341	15	0.9	0.52	4.1	29	Oxide of iron	0.021	0.256
											Oxide of manganese	0.00004	0.0005
											Benzine	0.0205	0.187
PKЦ	Sectional	1	1099	Stack	304	6	0.45	11.9	1.89	24	Oxide of iron	0.0096	0.038
											Oxide of manganese	0.000028	0.00009
											Carbon monoxide	0.028	0.129
											Nitrogen oxides	0.007	0.028
	Sectional	1	1234	Stack	305	6	0.6	2.5	0.71	23	Oxide of iron	0.0027	0.012
											Oxide of manganese	0.00001	0.00004
											Carbon monoxide	0.008	0.036
											Nitrogen oxides	0.0026	0.008
											Lead	0.000001	0.000004
	Heater	1	2015	Stack	306	6	0.6	3.4	1.96	120	Carbon monoxide	0.3555	2.58
											Nitrogen oxides	0.0592	0.43
	Welding post	1	1694	Stack	307	12	0.5	17.2	3.37	28	Oxide of iron	0.01	0.061
											Oxide of manganese	0.00002	0.00013
											Lead	0.000003	0.000023
	Grinding machine	1	185	Stack	308	12	0.35	2.1	0.2	28	Suspended materials	0.0012	0.0008
	Welding	1	2165	Stack	309	18	0.55	3.8	0.91	34	Oxide of iron	0.000034	0.000265
											Oxide of manganese	0.000008	0.000063
											Dust (20%<SiO_2<70%)	0.000017	0.00013
											Calcium fluoride	0.000055	0.00042
											Hydrofluoric acid	0.00001	0.000079
											Nitrogen oxides	0.00000034	0.000026
	Washing tank	1	995	Stack	310	10	0.3	11.2	0.8	34	Suspended materials	0.0012	0.0043
											Benzine	0.01	0.035
	Welding post	1	1315	Stack	311	10	0.4	4.3	0.56	25	Oxide of iron	0.0019	0.009
											Oxide of manganese	0.000005	0.000024
	Washing for parts	1	3406	Stack	312	12	0.6	8.8	2.32	40	Suspended materials	0.0053	0.065
											Benzine	0.0034	0.018

(Source: Tashkent Workshop)

Table 5 (3/3) Pollutant emissions parameters for Diesel Locomotive Building in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Emission	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	pollutants	g/s	ton/year
	Washing machine	1	347	Stack	313	8	0.55	1.8	0.43	49	Suspended materials	0.0012	0.0015
											Sodium hydroxide	0.000005	0.000026
											Benzine	0.0034	0.018
	Welding post	1	3444	Stack	314	18	0.63	0.25	0.75	32	Oxide of iron	0.0025	0.031
											Oxide of manganese	0.000005	0.00005
	Burning furnace	1	2814	Stack	315	5	0.3	4.1	0.29	110	Suspended materials	0.00468	0.04742
											Carbon monoxide	0.0061	0.06157
											Benzine	0.01	0.08272
	Washing machine	1	1597	Stack	317	10	0.3	6.9	0.49	40	Suspended materials	0.0012	0.0069
											Sodium hydroxide	0.000005	0.000028
											Benzine	0.0041	0.022
Diesel	Washing bath	1	215	Stack	319	18	0.45	3.1	0.49	38	Sodium hydroxide	0.000008	0.000006
											Suspended materials	0.0015	0.0188
											Benzine	0.006	0.075
	Grinding	1	806	Stack	342	18	0.6	5.9	1.5	23	Suspended materials	0.00648	0.01882
Instrumental	Mechanic	1	1365	Stack	343	15	0.5	1.83	0.36	27	Suspended materials	0.0012	0.0059
											Benzine	0.001	0.0049
	Electro-erosional	1	272	Stack	344	6	0.2	6.7	0.21	38	Suspended materials	0.0005	0.00049
											Benzine	0.001	0.0049
	Grinding	1	230	Stack	345	13	0.35	6.4	0.31	28	Suspended materials	0.0014	0.00116

(Source: Tashkent Workshop)

Table 6 Pollutant emissions parameters for new facilities of Diesel Locomotive Building in Tashkent Workshop in 2000

Section	Sources of Pollutants		Number of working hours in a year	Name of source	Source number	Height of source(m)	Diameter of Stack(m)	Emission of Pollutants			Name of pollutants	Maximum purification extent (%)	Emission in 2000	
	Name	Number						speed (m/s)	volume (m^3/s)	Temperature (℃)			g/s	ton/year
	Welding post	1	1088	Stack	420	15	0.3	10	0.97	25	Carbon monoxide		0.0124	0.0486
											Suspended materials	99	0.0142	0.0543
											Oxide of manganese	99	0.000021	0.000081
											Nitrogen oxides		0.000006	0.000024
											Oxide of iron	99	0.000132	0.0005
											Chromium anhydride		0.0000003	0.0000015
Turning car	Welding post	1	1514	Stack	423	15	0.35	10.8	0.38	25	Carbon monoxide		0.00532	0.029
											Nitrogen oxides		0.000017	0.000083
											Oxide of manganese	99	0.000029	0.000144
											Suspended materials	99	0.015	0.078
											Chromium anhydride		0.0000001	0.0000006
											Oxide of iron	99	0.000046	0.00024
											Calcium fluoride		0.0000006	0.0000014
	Painting room	1	1388	Stack	431	15	0.71	10.6	4.16	18	Paint aerosol		0.001	0.005
											Solvent		0.0371	0.28
	Drying room	1	2863	Stack	432	15	0.25	11.4	0.55	60	Solvent		0.129	1.33
	Washing bath	1	1038	Stack	433	15	0.225	10.5	0.42	40	Kerosene		0.084	0.314
	Medium	1	1035	Stack	440	17	0.355	10.1	0.97	25	Carbon monoxide		0.025	0.0932
											Oxide of manganese	99	0.00023	0.00165
											Oxide of iron	99	0.0026	0.0166
											Chromium anhydride		0.0000007	0.0000026
	Washing turning car	1	519	Stack	441	15	0.225	10.5	0.42	40	Sodium carbonate		0.046	0.0898
													0.019	0.036
Repair-complex	Grinding machine	1	915	Stack	443	10	0.63	16.3	5.05	18	Woody dust	98	0.037	0.122
	Covering cloth post	1	1035	Stack	446	15	0.225	10.5	0.4	20	Suspended materials	98	0.0133	0.0496
	Welding machine	1	1031	Stack	447	15	0.25	10.5	0.97	25	Oxide of manganese	99	0.000013	0.000026
											Oxide of iron	99	0.000132	0.000446
	Welding machine	1	538	Stack	448	15	0.25	10.2	0.98	25	Nitrogen oxides		0.000013	0.000026
											Carbon monoxide		0.00081	0.0015
											Suspended materials	99	0.00665	0.0223
											Oxide of manganese	99	0.000014	0.000053
	Welding post	1	1102	Stack	449	15	0.25	10.2	0.98	25	Oxide of manganese	99	0.000013	0.00005
											Oxide of iron	99	0.000108	0.0004

(Source: Tashkent Workshop)

Table 7 (1/2) Pollutant emissions parameters for foundry factory in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working hours in a year	Name of source	Source number	Height of source(m)	Diameter of Stack(m)	Emission of Pollutants			Name of pollutants	Emission(1992)		Emission(2000)	
	Name	Number						speed (m/s)	volume (m^3/s)	Temperature (℃)		g/s	ton/year	g/s	ton/year
		1	1360	Stack	132	6	0.6	6.8	1.95	18	Suspended materials	0.0296	0.145	0.0296	0.145
		1	1914	Stack	143	7	0.9	6.2	3.94	28	Suspended materials	0.0238	0.164	0.0238	0.164
		1	1651	Stack	135	8	0.3	12.3	0.87	28	Suspended materials	0.0037	0.022	0.0037	0.022
	Conveyor	1	1012	Stack	136	4	1	5	3.9	26	Suspended materials	0.00247	0.009	0.00247	0.009
	Heater	1	2018	Stack	138	5	0.6	3.2	0.9	150	Carbon monoxide	0.355	2.58	0.355	2.58
											Nitrogen oxides	0.0592	0.43	0.0592	0.43
	Conveyer	1	3065	Stack	140	9	0.8	5.5	2.75	28	Suspended materials	0.08	0.883	0.08	0.883
		1	112	Stack	144	12	0.45	10.3	1.63	27	Suspended materials	0.177	0.072	0.177	0.072
	Heater	1	879	Stack	145	6	0.45	3.2	0.51	28	Suspended materials	0.012	0.038	0.012	0.038
	Heater	1	2018	Stack	146	6	0.5	5.1	1	150	Carbon monoxide	0.355	2.58	0.355	2.58
											Nitrogen oxides	0.059	0.43	0.059	0.43
	Warm (heater)	1	2084	Stack	147	10	0.45	3.4	0.56	94	Suspended materials	0.00965	0.0724	0.00965	0.0724
											Carbon monoxide	0.01996	0.1238	0.01996	0.1238
											Nitrogen oxides	0.00361	0.0229	0.00361	0.0229
	Cutting metals	1	97	Stack	149	4	5.6	0.5	4.5	20	Carbon monoxide	0.014	0.0049	0.014	0.0049
											Nitrogen oxides	0.01	0.0039	0.01	0.0039
											Oxide of manganese	0.00064	0.00023	0.00064	0.00023
	Furnace for melting	1	1768	Stack	150	9	0.8	5.3	2.7	250	Carbon monoxide	0.201	1.28	0.201	1.28
											Nitrogen oxides	0.0335	0.217	0.0335	0.217
	Furnace	1	1704	Stack	153	10	0.7	5.9	2.27	250	Carbon monoxide	0.0678	0.416	0.0678	0.416
											Nitrogen oxides	0.01	0.0039	0.01	0.0039
											Sulfur anhydride	0.00791	0.05488	0.00791	0.05488
	Open-hearth furnace	1	2170	Stack	154	14	0.7	6.8	2.6	250	Suspended materials	0.4767	3.7249	0.4767	3.7249
											Carbon monoxide	0.0113	0.07	0.0113	0.07
											Nitrogen oxides	0.01365	0.08147	0.01365	0.08147
											Sulfur anhydride	0.0091	0.067	0.0091	0.067
	Furnace for drying rod	1	3714	Stack	155	25	1	3.4	2.67	150	Carbon monoxide	0.3753	5.019	0.3753	5.019
											Nitrogen oxides	0.0618	0.004	0.0618	0.004
	Drum for drying	1	1368	Stack	156	12	0.5	6.1	1.2	100	Carbon monoxide	0.04	0.197	0.04	0.197
											Nitrogen oxides	0.00672	0.033	0.00672	0.033
		1	1655	Stack	157	14	0.63	6.2	1.91	21	Suspended materials	0.08	0.477	0.08	0.477
	Furnace for burning	1	1730	Stack	130	6	0.8	5	2.5	250	Carbon monoxide	0.2772	1.727	0.2772	1.727
											Nitrogen oxides	0.0252	0.146	0.0252	0.146
	Room for blowing	1	416	Stack	128	14	0.5	10.1	1.98	25	Suspended materials	0.02	0.03	0.02	0.03
	Furnace for burning	1	1831	Stack	127	25	1	2.7	2.12	250	Nitrogen oxides	0.0267	0.176	0.0267	0.176
											Carbon monoxide	0.2782	1.804	0.2782	1.804
	Furnace for burning	1	1675	Stack	126	25	1	2.9	2.28	250	Nitrogen oxides	0.0285	0.176	0.0285	0.176
											Carbon monoxide	0.2907	1.804	0.2907	1.804
	Room for flowing	1	3388	Stack	124	8	0.6	8.4	2.37	23	Suspended materials	0.0782	0.954	0.0782	0.954
	Ventilation	1	1751	Stack	123	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	122	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	121	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	120	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	119	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	118	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	117	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Ventilation	1	1751	Stack	116	14	0.9	1.2	0.77	30	Suspended materials	0.0158	0.0996	0.0158	0.0996
	Pouring cast iron	1	3395	Stack	173	12	0.5	2	0.39	27	Suspended materials	0.081	0.99	0.081	0.99
											Carbon monoxide	0.1328	1.57	0.1328	1.57
	Pouring cast iron	1	3114	Stack	172	12	0.5	2.1	0.41	27	Suspended materials	0.066	0.74	0.066	0.74
											Carbon monoxide	0.07668	0.9087	0.07668	0.9087

(Source: Tashkent Workshop)

Table 7 (2/2) Pollutant emissions parameters for foundry factory in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Emission(1992)		Emission(2000)	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	pollutants	g/s	ton/year	g/s	ton/year
	Pouring cast iron	1	3114	Stack	171	12	0.5	2.1	0.41	27	Suspended materials	0.066	0.74	0	0
											Carbon monoxide	0.07668	0.9087	0	0
	Furnace for drying mold	1	1832	Stack	169	10	0.63	3.9	1.18	150	Suspended materials	0.033	0.21776	0.033	0.21776
											Carbon monoxide	0.1095	0.6805	0.1095	0.6805
											Nitrogen oxides	0.0219	0.1315	0.0219	0.1315
	Washing	1	3215	Stack	168	8	0.8	5.9	3.69	27	Suspended materials	0.0052	0.0602		
	Molding	1	3264	Stack	167	8	0.9	7.3	4.64	27	Suspended materials	0.0137	0.161		
	Mixing	1	321	Stack	178	9	0.95	3.7	2.62	25	Suspended materials	0.007	0.0081		
	Drum for grinding metal	1	3214	Stack	177	9	0.95	3.6	2.55	24	Suspended materials	0.0007	0.0081		
		1	3296	Stack	176	12	0.5	2.1	0.41	25	Suspended materials	0.075	0.89	0	0
											Carbon monoxide	0.1159	1.327	0	0
	Pouring cast iron	1	3296	Stack	175	12	0.5	2.1	0.41	25	Suspended materials	0.075	0.089	0	0
											Carbon monoxide	0.1159	1.327	0	0
	Pouring cast iron	1	3395	Stack	174	12	0.5	2	0.39	27	Suspended materials	0.081	0.99	0	0
											Carbon monoxide	0.132	1.57	0	0
	Cupola	1	4769	Stack	179	18	3.5	1.4	13.46	700	Suspended materials	0.216	3.709	0.216	3.709
											Carbon monoxide	6.04	41.49	6.04	41.49
											Sulfur anhydride	0.15	2.58	0.15	2.58
											Benzine	0.1753	3.01	0.1753	3.01
	Cupola	1	4769	Stack	180	18	3.5	1.4	13.46	700	Suspended materials	0.216	3.709	0.216	3.709
											Carbon monoxide	6.04	41.49	6.04	41.49
											Sulfur anhydride	0.15	2.58	0.15	2.58
											Benzine	0.1753	3.01	0.1753	3.01
	Cupola	1	4769	Stack	181	18	3.5	1.4	13.46	700	Suspended materials	0.216	3.709	0.216	3.709
											Carbon monoxide	6.04	41.49	6.04	41.49
											Sulfur anhydride	0.15	2.58	0.15	2.58
											Benzine	0.1753	3.01	0.1753	3.01
	Belt conveyer	1	3386	Stack	183	12	0.6	1.63	0.38	28	Suspended materials	0.0137	0.167	0.0137	0.167
	Electric furnace	1	2043	Stack	640	12	0.71	10.6	4.16	25	Carbon monoxide			0.028	0.206
											Sulfur anhydride			0.000032	0.00023
											Nitrogen oxides			0.0056	0.04
											Calcium fluoride			0.00001	0.0008
											Cyanide			0.00059	0.0042

(Source: Tashkent Workshop)

Table 8 Pollutant emissions parameters for galvanic and elector-apparatus factory in Tashkent Workshop in 1992

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Emission(1992)		Emission(2000)	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	pollutants	g/s	ton/year	g/s	ton/year
Galvanic factory	Chromic bath	1	3282	Stack	207	8	0.5	7.5	5.4	23	chromium anhydride	0.000011	0.00013	0.000011	0.00013
											Sodium hydroxide	0.001	0.121	0.001	0.121
	Etching bath	1	3282	Stack	208	8	0.5	7.5	5.4	23	Sulfuric acid	0.0036	0.016	0.0036	0.016
	Etching bath	1	748	Stack	209	8	0.5	6.7	3.02	39	Sodium hydroxide	0.00375	0.01011	0.00375	0.01011
	Etching bath	1	1562	Stack	211	10	0.2	10.2	0.31	21	Suspended materials	0.0008	0.0045	0.0008	0.0045
	Accumulator charge	1	3273	Stack	215	9	0.7	4.9	1.89	20	Sodium hydroxide	0.00201	0.02369	0.00201	0.02369
											Sulfuric acid	0.0042	0.0275	0.0042	0.0275
	Nickel bath	1	138	Stack	467	15	0.28	11.2	0.69	45	Nickel			0.0016	0.0008
ГСМ	Coil repair	1	1641	Stack	267	8	0.3	5.9	0.42	19	Suspended materials	0.0011	0.0065	0.0011	0.0065
											Benzine	0.0099	0.065	0.0099	0.065
											Lead	0.00000075	0.000005	0.00000075	0.000005
Electro-apparatus factory	Drying	1	185	Stack	268	8	0.08	4.2	0.02	38	Suspended materials	0.00006	0.00004	0.00006	0.00004
	Bath		32	non-organized	269	4	5.6	0.5	4.5	20	Benzine	0.0043	0.0005	0.0043	0.0005
											Suspended materials	0.0028	0.016	0.0028	0.016
	Warehouse	1	1587	Stack	270	6	0.6	1.3	0.38	28	Suspended materials	0.0028	0.016	0.0028	0.016
	Warehouse	1	1587	Stack	271	6	0.6	1.3	0.38	28	Suspended materials	0.0028	0.016	0.0028	0.016
	Ventilation	1	1481	Stack	272	9	0.5	0.57	0.11	28	Suspended materials	0.00045	0.0024	0.00045	0.0024

(Source: Tashkent Workshop)

Table 9 Wastes produced from Tashkent Workshop

Type of Waste	Produced Waste		Recycle		Non-used Waste	
	Source of Waste	Quantity ton/year	Quantity ton/year	Way of Use	Quantity ton/year	Destination
glass	replacement from coach	80	80	reproducing plant		
linoleum	replacement from coach	42	20	to be sold to population	22	municipal disposal place
wall paper	replacement from coach	51			51	municipal disposal place
artificial leather	replacement from coach	59			59	municipal disposal place
isolation material (cotton glass)	some phases of technology process	61			61	municipal disposal place
rubber	some phases of technology process	26			26	municipal disposal place
hard paper	some phases of technology process	5	5	reproduction plant		
wood	some phases of technology process	580	580	to be sold to population		
cloth for cleaning	some phases of technology process	65			65	municipal disposal place
oil and grease	runoff of lubricants and waste of cleaning machines	369	100	regeneration	269	oil base
metal	rejected products (spare parts)	11845			11845	reproducing plant
burned earth	from casting shop and foundry shop	600			600	municipal disposal place
garbage (with leaves)	from all parts	1000			1000	municipal disposal place
construction wastes	small construction (20% combustible)	500			500	municipal disposal place

(Source: Tashkent Workshop)

Appendix 5-3 Data on Environmental Condition of Uzbekistan Depot

Table 1 Water Consumption at Sections of Uzbekistan Depot (Industrial Need)

Name of item	Number of Units	Norm of water consumption (m^3)	Annual consumption (day/year)	(m^3)
1. Main Depot (TP-1, TP-2 and other shops) Washing section Washing of parts and details	1,335 sections	1		1,335
2. Mechanic section Machine maintenance and its cooling	8 machines	0.035	365	102.2
3. Rheostat diesel loco tests	7 sections per year	11		77
4. Washing locomotives Outside (external) washing electric locomotives	1,212 sections	2		2424
5. Outside washing of electric sections	5,986 sections	2		11,972
6. Outside washing diesel locomotives	55 sections	2		110
7. Accumulator washing and charging	11,175.50	2		22,351
8. Compressor 6 hours/day *10 m^3/min	600 minutes	0.0025	365	5,749
9. Compressor in TP-1, production of 18 m^3/min	1,200 minutes	0.004	365	18,834
10. Compressor at the sand drying machine production of 5.3 m^3/min	1,440	0.0025	365	7312.4
11. Forging section Hammer	1	0.04	307	12.28
12. Servicing personnel	0.5	5	307	767.5
13. O Г M				
a) Preparation of cold mixture of concrete	10 m^3	0.275	307	844.25
b) Preparation of lime mixture solution	3 m^3	0.22	307	270.16
c) Watering of concrete in summer	20 m^3	0.4	153	1,224
d) Brickwork with a cold mixture solution	4,000 bricks	0.18		720
e) Preparation of cement	20 m^3	0.304	307	1842
f) Plastering works	400 m^3	0.004	307	491.2
g) Lime slake	25 tons	4		100
14. Vehicles				
a) Washing of freight vehicles (trucks)	5	0.8	365	1,460
b) Washing of sedan cars	6	0.5	365	1,095
c) Washing of bus	2	2.5	365	1,825
d) Washing of motor	2	0.025	365	18.25
e) Repair of freight cars 1month per vehicle	5	0.7	30	105
f) Repair of sedan cars	6	0.5	30	90

(Source: Uzbekistan Depot)

Table 2 (1/2) Water Consumption at Sections of Uzbekistan Depot (Drinking and Domestic Need)

Name of item	Number of Units	Norm of water consumption (m^3)	Annual consumption (day/year)	(m^3)
1. Canteen				
a) Preparation of lunch	300 dishes	0.036	365	3942
b) Washing of dishes	6	0.25	365	547.5
c) Drinking/ domestic need of personnel	5 people	0.025	365	45.63
2. Food-stuffs shop	1 people	0.02	307	6.1
3. Drinking/domestic needs of workers	230 people	0.025	365	2098.75
4. Hand-washing basin	4	0.06	365	876
5. Shower	2307 people	0.04	365	3958
6. Cleaning of rooms	28000 m^3	0.08	365	8176
7. Administrative building	100 people	0.1864		18.64
8. Administrative building	100	0.025	365	912.5
9. Equipping of diesel locomotives	7 section	0.18	365	460
b) Full cooling system at the equipping	7	0.1	183	128.1
10. Laboratory				
a) Filter preparation	5 filters	0.36	365	657
b) Distillate preparation for accumulator charging		0.18	365	65.7
11. Watering of territory	82000 m^2	0.004	212	69536
12. Watering of green plants	100	0.004	212	84.8
13. Buffet	2	0.25	307	153.3
14. Boiler room	3	150	130	58500
15. Domestic need of personnel	1 people	0.025	307	7.62
16. Chemical laundry	3	0.08x25	307	1842
17. Fire extinguisher charging section	1 charge/day	0.25	365	91.3
18. Acetylene charging welding section	1 charge/day	0.35	365	127.75
19. Toilet/running water per day	1	3.5	365	1310
20. Preparation of soda water tab in TP-1	1	0.3	365	1314

(Source: Uzbekistan Depot)

Table 2 (2/2) Water Consumption at Sections of Uzbekistan Depot

(Technical Maintenance of Railcars)

Name of item	Number of Units	Norm of water consumption (m^3)	Annual consumption (day/year)	Annual consumption (m^3)
1. Drinking /domestic needs	3 people	0.035	365	38.325
2. Washing wagons	1504 sections	0.002	365	1097.9
3. Showers	3 people	0.04	200	24
4. Hand-wash basin	3 people	0.025	365	27.34

(Team rest house in Uzbekistan station)

1. Domestic needs	3 people	0.025	365	27.37
2. Watering of territory	1500 m^3	0.004	212	1272
3. Rest house of locomotive teams	45 people	0.025	365	410.6
4. Watering of gardens	600 m^3	0.025	212	3180
5. Showers	45 people	0.06	365	985.5

(Source: Uzbekistan Depot)

Table 3 (1/2) Pollution Emissions Parameters (into atmosphere) for Uzbekistan Depot (Source: Uzbekistan Depot)

Section	Sources of Pollutants		Number of working hours in a year	Name of source	Source number	Height of source(m)	Diameter of Stack(m)	Emission of Pollutants			Name of treatment	Quality of treatment (%)	Name of pollutants	Emission	
	Name	Number						speed (m/s)	volume (m^3/s)	Temperature (℃)				g/s	ton/year
Fire extinguisher charge section	Tank	1	1178	Stack	1	3	0.2	10	0.314	35.7	-	-	Alkaline	0.00022	0.0014
Engine rewinding section	Varnish bath	1	254	Stack	2	2	0.4	9	1.13	35.7	-	-	Xylene	2.6	0.01
													White spirit	2.6	0.01
Accumulator charge section	Accumulator	1	1270	Stack	3	2.5	0.15	9.5	0.168	35.7	-	-	Sulfuric acid	0.000006	0.0003
Accumulator charge section	Bath	2	127												
	Accumulator	1	1178	Stack	4	12	0.3	11	0.777	35.7	-	-	Alkaline	0.00027	0.000005
Experimental section	Grinding machine	1	365	Stack	5	5	0.35	2.46	0.237	35.7	э и л -900	95	Abrasive metal dust	0.0022	0.00289
	Mechanical saw	1	365										Oxides of iron	0.03548	0.23346
	Planer	1	365										Oxides of manganese	0.010553	0.00709
	Lathe	1	365										Nitrogen oxides	0.0178	0.117
	Lathe	1	2190										Carbon monoxide	0.0176	0.11571
	Welding unit	1	2555										Emulsion	0.000037	0.00022
	Gas welding	1	1825	Stack	6	7	0.25	9.5	0.0466	35.7	-	-			
Pressing black-smith section	Smith forge	1	3650	Stack	7	12	0.5	11	2.159	120	-	-	Solid substance	0.03367	1.0474
													Carbon monoxide	0.00557	0.1655
													Nitrogen oxides	0.00247	0.0325
Mechanic Section	Milling machine	1	3650												
	Planer	2	3650												
	Lathe	3	3650												
	Face grinding machine	1	1095												
	Cylindrical grinding machine	1	730	Stack	8	12	0.45	10	1.59	35.7	-	-	Emulsion	0.000375	0.00142
													Abrasive metal dust	0.0097	0.05206
	Grinding machine	1	1825	Stack	9	5	0.35	2.46	0.237	35.7	э и л -900	95	Abrasive metal dust	0.0022	0.00289
Fuel equipment section	Bathe	2	1460										Kerosine	0.10825	0.57
	Test stand	1	2190	Stack	10	5	0.15	9.5	0.168	35.7	-	-	Hydrocarbon	0.1794	0.663
Organic materials washing section	Bathe	2	3650												
	Washing stand	1	3650	Stack	11	12	0.25	9.5	1.864	35.7	-	-	Induction oil	0.0000013	0.000018
Welding section	Electric welding	1	1778										Oxides of iron	0.03548	0.23346
	Gas welding	1	1270										Oxides of manganese	0.010553	0.00539
													Nitrogen oxides	0.0178	0.117
				Stack	12	1.5	0.15	10.5	0.186	35.7	-	-	Carbon monoxide	0.0176	0.11571
													Oxides of iron	0.0027	0.00437
	Welding unit		365	Stack	13	1.5	0.15	10	0.177	35.7	-	-	Oxides of manganese	0.00019	0.00031
	Grinding machine	1	365	Stack	14	1.5	0.1	9.5	0.074	35.7	-	-	Abrasive metal dust	0.023	0.0302
	Grinding machine	1	730	Stack	15	5	0.35	2.46	0.237	35.7	э и л -900	95	Abrasive metal dust	0.022	0.00156
Washing section	Washing machine	1	730	Stack	16	10	0.25	10.5	1.01	35.7	-	-	Sodium carbonate	0.01	0.02628
Grinding section	Turret lathe	1	1095	Stack	17	12	0.35	10.5	1.01	35.7	-	-	Emulsion	0.000018	0.01095
OTM	Electric welding	1	3650										Oxides of iron	0.03548	0.14902
	Gas welding	1	1095										Oxides of manganese	0.010553	0.00539
	Lathe	1	730	Stack	18	7	0.4	12	1.507	35.7	-	-	Nitrogen oxides	0.0178	0.0702
													Carbon monoxide	0.0176	0.0694
													Emulsion	0.000018	0.01095
	Grinding machine	1	365	Stack	19	5	0.35	2.46	0.237	35.7	э и л -900	95	Abrasive metal dust	0.0022	0.00289
Fuel	Tank	14	8760										Diesel fuel	0.00022	0.00118
	Gas station	2	1825		20	10	0.5	1.6	0.314	35.7	-	-	Benzine	0.005	0.15892
													Mineral oil	0.00002	0.0005
													Hydrocarbon	0.8235	0.0948
Garage	Cylindrical grinding machine	1	762										Emulsion	0.000018	0.0005
													Abrasive metal dust	0.0176	0.19105
	Grinding machine	1	254		21	10	0.5	1.6	0.314	35.7	-	-			

Table 3 (2/2) Pollution Emissions Parameters (into atmosphere) for Uzbekistan Depot (Source: Uzbekistan Depot)

Section	Sources of Pollutants		Number of working	Name of source	Source	Height of	Diameter of	Emission of Pollutants			Name of	Quality of	Name of	Emission	
	Name	Number	hours in a year		number	source(m)	Stack(m)	speed (m/s)	volume (m^3/s)	Temperature (℃)	treatment	treatment (%)	pollutants	g/s	ton/year
ДОЦ	Universal machine	2	1270												
	Circular saw	1	1524												
	Marking machine	1	1524	Stack	22	3	0.5	1.6	0.314	35.7	Cyclone		Wood dust	0.3091	1.1871
	Cross-cut saw	1	254												
	Single-band saw	1	508												
	Universal machine	1	254		23	10	0.5	1.6	0.314	35.7	-	-	Wood dust	11.052	12.6598
	Painting	1	254		24	10	0.5	1.6	0.314	35.7	-	-	Butyl acetate	0.0044	0.04834
													Ethylcellosolve	0.0035	0.02027
													Acetone	0.0031	0.06762
													Ethanol	0.0066	0.038
													Butanol	0.0066	0.038
													Paint aerosol	0.0085	0.04896
													Toluene	0.0198	0.233
Chemical laundry	Machine	1	3650	Stack	25	7	0.5	11.2	2.8	50	-	-	Tetrachloroethene	0.014	0.018396
Boiler room	Boiler	3	6036	Stack	26	28	0.6	11.5	3.25	180	-	-	Carbon monoxide	1.69	17.8299
													Nitrogen oxides	0.44163	4.6584
Hard-facing of coupling parts section	Welding unit	2	879										Oxides of iron	0.00475	0.014565
	Electric welding	1	1270										Oxides of manganese	0.000338	0.001092
	Grinding machine	1	254										Oxides of chromium	0.000005	0.00002
	Manual grinding machine	1	508	Stack	27	12	0.3	12.4	0.876	35.4	-	-	Abrasive metal dust	0.067	0.08229
	Varnishing of coupling parts	1	508		28	10	0.5	1.6	0.314	35.7	-	-	Xylene	0.368	0.0005
													White spirit	0.832	0.00112
Mechanical shop	Grinding machine	2	730												
	Drilling machine	2	2920												
	Planing machine	1	1825										Abrasive metal dust	0.096	0.47563
	Face grinding machine	1	2190	Stack	29	12	0.4	11.5	1.444	35.7	-	-	Emulsion	0.000271	0.002248
	Grinding machine	1	1825	Stack	30	5	0.35	2.46	0.27	35.7	з и л-900	95	Abrasive metal dust	0.0022	0.00289
Polymer section	Hydraulic press	3	3650	Stack	31	12	0.35	10.5	1.01	70	-	-	Phenol	0.3306	0.00438
Babbit section	Electrical Induction furnace	1	730	Stack	32	12	0.4	10.5	1.319	100	-	-	Lead aerosol	0.00001	0.000026
	Electrical Induction furnace	1	730	Stack	33	10	0.4	11	1.382	100	-	-	Lead aerosol	0.00001	0.000026
	Box of bearings scraping	1	730	Stack	34	12	0.25	10.5	0.515	100	-	-	Lead dust	0.002	0.00525
Construction section	Crushed stone storage	1	8760		35	10	0.5	1.6	0.314	35.7	-	-	Crushed stone dust	2.35224	27.38241
	Cement storage	1	8760		36	10	0.5	1.6	0.314	35.7	-	-	Cement dust	0.0122	0.00567
	БСУ	1	1270		37	10	0.5	1.6	0.314	35.7	-	-	Cement sand dust	0.000378	0.001729
	Sand storage	1	8760		38	10	0.5	1.6	0.314	35.7	-	-	Sand dust	0.00757	0.02435
Drying section	Sand drying room	1	4380	Stack	39	10	0.25	11.5	0.564	80	-	-	Sand dust	1.805	54.75
													Suspended solid	0.00168	0.3285
													Carbon monoxide	0.0219	4.281
													Nitrogen oxides	0.00542	1.0591
													Oxides of sulfur	0.01344	2.628
													V_2O_5	0.000027	0.00523
	Distributing bunker	1	4380		40	10	0.5	1.6	0.314	35.7	-	-	Sand dust	0.027	0.87127
Rheostat	Diesel locomotive	1	1095	Stack	41	4.7	0.3	1.4	0.1	100	-	-	Carbon monoxide	2.058	11.9262
													Nitrogen oxides	5.292	28.561
													Hydrocarbons	2.646	13.78
													Oxides of sulfur	0.588	2.756
													Ash	0.3675	0.2808

Table 4 (1/2) Pollutant emissions parameters in future perspective for Uzbekistan Depot

Section	Sources of Pollutants		Number of working hours in a year	Name of source	Source number	Height of source(m)	Diameter of Stack(m)	Emission of Pollutants			Name of treatment	Quality of treatment (%)	Name of pollutants	Emission	
	Name	Number						speed (m/s)	volume (m^3/s)	Temperature (℃)				g/s	ton/year
Filter repair section	Washing and drying filter unit	1													
	Parts washing bath	1		Stack	42	8	0.5	7.8	1.53	35.7	-	-	Hydrocarbons	0.03	0.25
	Sedimentation tank	1													
	Washing machine	1													
	Bath for impregnation	1		Stack	43	9	0.355	16	1.6	35.7	-	-	Hydrocarbons	0.04	0.44
	Gas welding	1											Nitrogen oxides	0.005	0.05
	Electric welding	1											Carbon monoxide	0.006	0.06
	Welding machine	1		Stack	44	9	0.315	6.9	0.53	35.7	-	-	Oxides of manganese	0.002	0.02
													Silicon	0.001	0.01
													Oxides of iron	0.0298	0.298
Electric units repair section	Parts heating and drying box	1											Lead aerosol	0.000005	0.00004
													Hydrocarbon	0.001	0.01
	Electric bath for welding nozzle	1		Stack	45	8	0.5	1.27	0.25	35.7	-	-	Lead aerosol	0.0000002	0.000005
Refrigerator repair section	Stand	2		Stack	46	9	0.4	3.4	0.42	35.7	-	-	Alkaline	0.0026	0.0211
													Sulfuric acid	0.013	0.1
Assembly-line operation of diesel locomotive repair	Welding chamber	1		Stack	47	17	0.25	18	0.87	35.7	-	-	Oxides of manganese	0.006	0.05
													Silicon	0.002	0.02
													Fluorides	0.003	0.03
													Oxides of iron	0.018	0.03
	Paint chamber	1		Stack	48	17	0.63	6.3	1.8	35.7	-	-	Xylene	0.3	2.7
	Drying chamber	1		Stack	49	17	0.25	10	0.5	100	-	-	Xylene	0.04	0.36
	Washing machine	1		Stack	50	17	0.63	9	2.5	80	-	-	Alkaline	0.007	0.007
Transformer inspection section	Drying unit	1		Stack	51	17	0.28	13.5	0.83	100	-	-	Xylene	0.03	0.27
Wheel lathe section	Wheel washing machine	2		Stack	52	17	0.315	8.4	0.6	95	-	-	Alkaline	0.0002	0.002
	Chamber for air cooling of engine and generator	1		Stack	53	17	0.56	10	2.5	35.7	-	-	Inorganic dust	0.2	0.4
	Bearing washing machine	1		Stack	54	17	0.25	5.1	0.25	80	-	-	Alkaline	0.0002	0.002
	Chamber for air cooling of parts of engines	1		Stack	55	17	0.56	10	2.5	35.7	-	-	Inorganic dust	0.3	0.6
	Collector soldering unit	1		Stack	56	17	0.18	2.8	0.07	35.7	-	-	Lead aerosol	0.000006	0.000054
Impregnating and drying section	Drying furnace	3		Stack	57	8	0.63	4.8	1.5	100	-	-	Xylene	0.09	0.8
	Dyeing chamber	1		Stack	58	17	0.9	10	6.25	35.7	-	-	Xylene	0.3	2
	Impregnating armature unit	1		Stack	59	8	0.7	1.7	0.65	35.7	-	-	Xylene	0.039	0.339
Roller section	Washing machine	1		Stack	60	17	0.9	10	6.25	35.7	-	-	Alkaline	0.0002	0.002
	Engine washing unit	1		Stack	61	17	0.2	17.4	0.55	80	-	-	Alkaline	0.0002	0.002
Polymer section	Polymerization chamber	1													
	Revolving stand	1													
	Ventilator cabin	1		Stack	62	8	0.4	13.2	1.65	35.7	-	-	Acetone	0.2	0.3
	Absorbing box	1		Stack	63	8	0.25	8.8	0.43	35.7	-	-	Hydrocarbon	0.03	0.25

(Source: Uzbekistan Depot)

Table 4 (2/2) Pollutant emissions parameters in future perspective for Uzbekistan Depot

Section	Sources of Pollutants		Number of working hours in a year	Name of source	Source number	Height of source(m)	Diameter of Stack(m)	Emission of Pollutants			Name of treatment	Quality of treatment (%)	Name of pollutants	Emission	
	Name	Number						speed (m/s)	volume (m^3/s)	Temperature (℃)				g/s	ton/year
Babbit section	Furnace for babbit	1													
	Electric furnace	1													
	Induction bath	2													
	Babbit machine	1													
	Babbit bath	1		Stack	64	8	0.4	12.7	1.6	150	-	-	Lead aerosol	0.000001	0.00001
	Bearing's mold and repair	1		Stack	65	8	0.4	6.6	0.88	35.7	-	-	Hydrocarbon	0.05	0.5
Blacksmith sectio	Forge	1		Stack	66	8	0.4	5.7	1.11	150	-	-	Carbon monoxide	0.02	0.18
													Nitrogen oxides	0.001	0.009
Thermal section	Induction unit	1													
	Electric furnace	1											Benzine	0.0008	0.004
	Oil tank	1		Stack	67	8	0.315	15	1.16	150	-	-	Hydrocarbons	0.001	0.05
	Washing machine	1		Stack	68	3.5	0.15	7.4	0.18	50	-	-	Alkaline	0.001	0.004
													Hydrocarbons	0.009	0.033
	Welding post	1		Stack	69	13.4	0.2	13.3	0.42	35.7	-	-	Oxides of manganese	0.0002	0.003
													Silicon	0.0005	0.007
													Fluoride	0.0048	0.07
													Oxides of iron	0.0048	0.07
Boiler room	Boiler	4		Stack	70	30	1.6	11.8	23.7	142	-	-	Nitrogen oxides	1.618	17.05
													Carbon monoxide	6.214	65.56

(Source: Uzbekistan Depot)

Table 5 Noise in the Working Place for Uzbekistan Depot

Place / Additional Information	Noise Characteristics: Spectra: Wide band width	Spectra: Tense	Time characteristics: Constant	Time characteristics: Vibrated	Time characteristics: Interrupted	Time characteristics: Impulse	Levels of Noise pressure in dB and in octave lines in Hz: 31.5	63	125	250	500	1000	2000	4000	8000	BA
Maximum allowable level							107	95	87	82	78	75	73	71	69	80
TP-1 shop Babbit machine	+			+			74	70	72	76	73	75	68	70	65	80
Ventilation fan (excess)	+		+				71 1	74 9	73 6	72 1	73 5	69	65 2	60	58	71
Pneumatic press for rubber and plastics (excess)	+			+			92	89	83	79	80 2	82 7	75 2	72 1	69	82 2
Hydric press (excess)	+			+			74	65	72	67	73	77 2	72	70	66	77
Equipment test stand (excess)	+				+		98	92	88 1	83 1	85 7	87 12	83 10	80 9	78 9	98 18
Sharpening machine (excess)	+			+			65	64	67	75	79 1	81 6	79 6	74 3	72 3	82 2
Drilling machine	+			+			70	72	74	68	71	74	73	68	60	70
Lathe							74	75	77	80	78	75	74	69	64	76
Tool room (excess)	+			+			92	88	90 3	87 5	89 11	85 10	80 7	88 7	75 6	91 11
Milling machine No.1986	+			+			80	76	74	77	75	73	70	69	61	74
Test grinding machine No 9359 (excess)	+			+			75	77	74	77	80 2	75	74 1	72 1	70 1	83 3
Machine shop milling machine No.5147	+			+			73	72	75	75	71	68	70	67	63	74
Planing machine No 5582 (excess)	+			+			80	77	79	82	80 2	77 2	79 6	75 4	72 3	82 2
Grinding machine No 3108 (excess)	+			+			84	78	73	77	75	76 1	70	72 1	70 1	78
Tool grinding machine No 9382 (excess)	+			+			79	80	77	78	81 3	80 5	77 4	79 8	76 7	85 5
Lathe No 808 (excess)	+			+			73	74	76	78	77 2	74 1	70	64	64	79
Lathe No.1500 (excess)	+			+			72	74	77	79	76	74	77 4	72 1	66	76
Mechanic scissors (excess)	+			+			75	79	77	78	82 4	83 8	76 3	72 1	70 1	85 5
Drilling machine	+			+			66	64	70	75	71	66	64	62	60	73
Compressor repair shop repair work	+			+			75	73	69	70	72	66	60	58	56	67
Compressor test (excess)	+			+			80	82	90 3	96 14	88 10	84 9	82 9	73 2	70 1	87 7
TP3 shop bogie repair section	+			+			76	74	74	77	75	73	73	71	65	77
Lathe No.4254	+			+			72	71	76	79	77	75	72	72	63	78
Bogie assembling section (excess)	+			+			77	74	76	78 1	80 2	79 4	76 3	74 1	67	82 2
Shop for automatic coupling repair sets (excess)	+			+			79	77	69	74	78	80 5	84 8	78 7	80 11	85 5
Welding	+			+			71	74	72	78	75	72	71	68	63	74
Machine shop lathe No.1292	+			+			75	73	74	76	70	72	68	64	64	74
Tool grinding machine (excess)	+			+			78	77	73	76	80 2	74	75	72	70 1	81 1
Section for top equipment repair (excess)	+			+			72	70	75	71	74	77 2	78 5	70	66	76
Pantograph test stand	+			+			69	67	68	71	73	65	67	64	51	62
Regulation of resetting equipment stand	+			+			70	64	65	67	64	62	60	57	55	66
Suppression test stand	+			+			76	75	77	70	72	71	74	68	60	72
Electrical equipment shop	+			+			62	58	60	63	64	63	58	55	50	70
Equipment regulation stand	+			+			65	62	66	70	65	67	61	60	57	73
Relay regulation stand	+				+		60	63	62	57	59	51	47	45	42	60
Tool grinding machine (excess)	+			+			70	69	70	74	79 1	80 5	78 5	77 6	70 1	86 6
Electrical machine shop																
Winding section	+			+			68	62	64	66	65	68	65	62	57	70
Welding section	+			+			69	70	67	70	72	71	67	63	60	72
Hard facing under flux	+			+			70	73	75	74	77	72	70	67	62	73
Planing machine (excess)	+			+			79	80	85	78	93 15	90 15	84 11	83 12	80 11	100 20
Surface marking machine (excess)	+			+			80	79	88 1	92 10	90 12	89 14	85 12	80 9	77 8	94 14
Circular Saw (excess)	+			+			76	83	81	85 3	85 8	90 15	92 19	94 23	86 17	102 22
Rocking type Saw (excess)	+			+			81	78	90	87	89	89	86	90	85	94
TP1 shop																
Beginning along central line	+			+			70	74	72	70	71	72	69	67	61	74
In the middle	+			+			73	78	75	74	76	73	71	70	65	78
At the end, automatic coupling section (excess)	+			+			71	66	74	77	75	72	73	73 2	70	80
During shunting locomotive working (excess)	+			+			77	79	76	78 4	80 2	78 3	76 3	74 6	72 3	82 2
Overhead travelling crane (excess)	+			+			68	74	75	75	73	76 1	70	68	66	79

(Source: Uzbekistan Depot)

Table 6 (1/2) Inside air measurements under 100% capacity of equipment for Uzbekistan Depot (1995)

Location for sampling (comments)	Temperature (°C)	Relative humidity (%)	Distance from the floor (m)	Distance from the source (m)	Aspiration speed (L/min)	Component	Determined Concentration (mg/m³)	Maximum allowable concentration (mg/m³)
Section of automatic coupling repair Working place (ventilation fan (working))	23.5	71	1.5	0.5	20	Welding aerosol	26 22.8 28.1	4
					10	Mn aerosol	0.04 0.03 0.04	0.2
					10	Chromium anhydride	0.0231 0.0399 0.0378	0.01
					300mL	Nitrogen oxides	7 8.5 7	2
						Carbon monoxide	25 38 43.7	20
In the middle of room	23.5	71	1.5	0.5	20	Welding aerosol	15.4 13.3 9.5	4
					10	Chromium anhydride	0.0126 0.0063 0.0063	0.01
					300mL	Nitrogen oxides	2 3 2	2
						Carbon monoxide	25 25 38	20
Grinding by manual grinding machine	26	42	1.5	0.5	20	Metal dust	12.9 10.2 15.6	6
Mechanic shop								
Tool grinding machine (No ventilation, windows and doors are open)	21	65	1.5	0.5	20	Abrasive dust	44.7 53.2 50.5	6
Boring of lead plain bearings	21	65	1.5	0.5	20	Lead aerosol	0.028 0.05 0.04	0.01
						Metal dust	8.9 17.9 13.2	6
Boring of bronze parts (There is ventilation)	21	65	1.5	0.5	20	Bronze dust	3.9 3.8 2.6	6
						Lead aerosol	0.0052 0.0052 0.004	0.01
Boring of balance rollers (No ventilation)	22	62	1.5	0.5	20	Iron dust	4.2 5.8 4.7	6
Tool shop								
Tool grinding machine (No ventilation)	22	65	1.5	0.5	20	Abrasive dust	13.7 12.1 11.1	6
Shaft turning (No ventilation)	22	65	1.5	0.5	20	Metal dust	3.2 1.8 2.6	6
Polymer section								
Vulcanization of rubber (No ventilation, not working)	23	52	1.5	0.5	5	Acrolein	not detected not detected not detected	0.2
						Sulfur anhydride	not detected not detected not detected	10
						CO	15 15 20	20

(Source: Uzbekistan Depot)

Table 6 (2/2) Inside air measurements under 100% capacity of equipment for Uzbekistan Depot (1995)

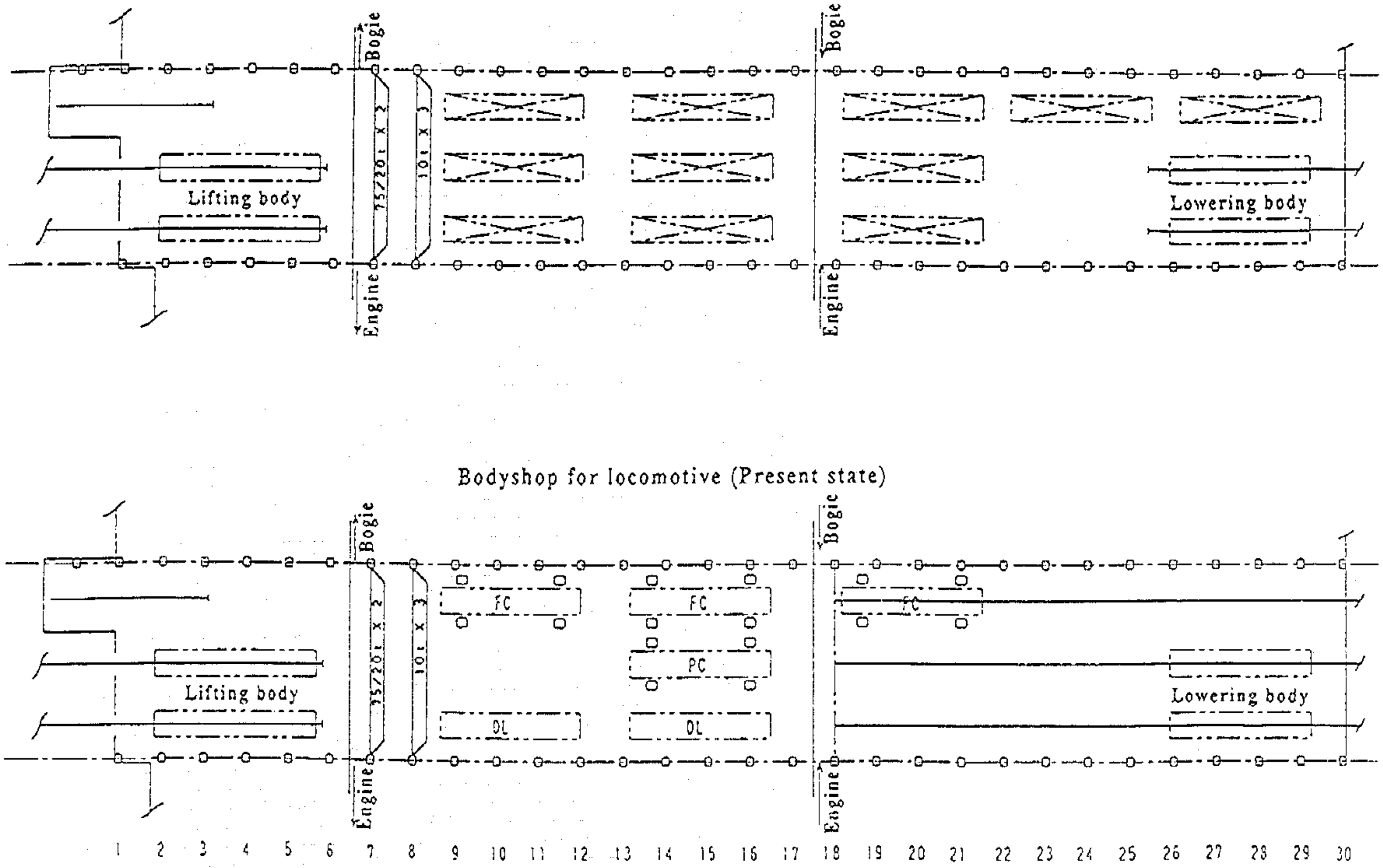
Location for sampling (comments)		Temperature (°C)	Relative humidity (%)	Distance from the floor (m)	Distance from the source (m)	Aspiration speed (L/min)	Component	Determined Concentration (mg/m³)	Maximum allowable concentration (mg/m³)
Calcium casting section									
Melting furnace for babbit pigs				1.5	0.5	20	Lead aerosol	0.018	0.01
								0.013	
								0.017	
Bearing boring (local ventilation)				1.5	0.5	20	Lead aerosol	0.018	
								0.016	
								0.015	
						1	Hydrochloric acid	0.16	5
								0.46	
								0.58	
Calcination section									
Dust from	window						Lead	0.03 mg	none (should not be)
	door							0.02 mg	
	window-sill							0.07 mg	
								0.03 mg	
	wall							not detected	
	table for in-instruments							0.06 mg	
	radiator							0.09 mg	
	blower							0.12 mg	
	samovar							not detected	
	cup							not detected	
ДОЦ									
Jointing machine (no ventilation)		20	68	1.5	0.5	20	Wood dust	5.8	6
								5.3	
								4.7	
Lathe (no ventilation)							Wood dust	7.4	
								10	
								10.5	
Marking machine (no ventilation)							Wood dust	17.4	
								32.1	
								28.4	
Circular saw (no ventilation)							Wood dust	105.8	
								52.1	
								82.1	

(Source: Uzbekistan Depot)

Appendix 11.2.1 Workshop Design

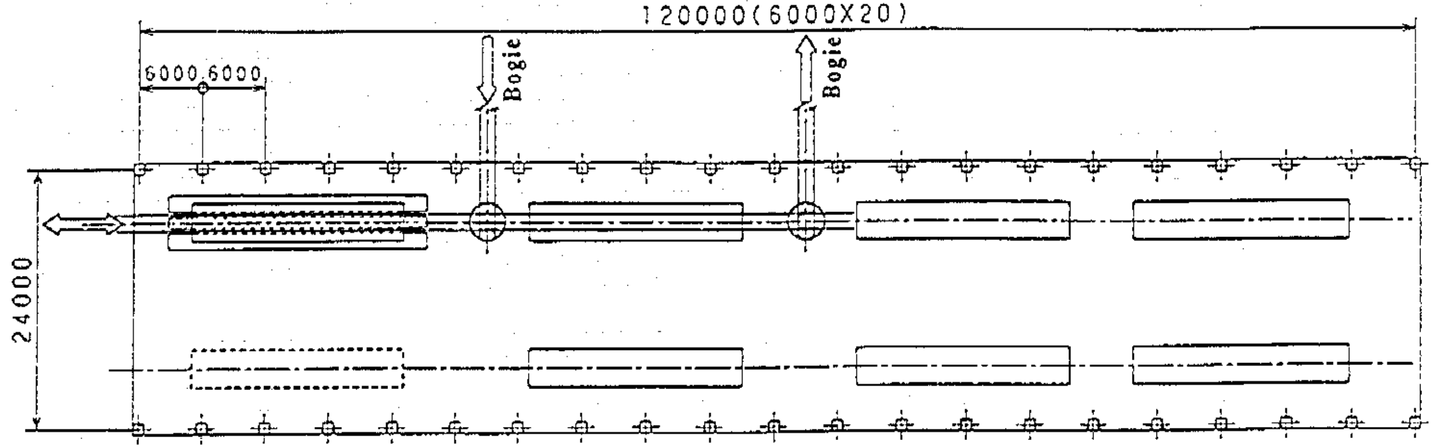
Bodyshop for locomotive (improvement)

Bodyshop for locomotive (Present state)

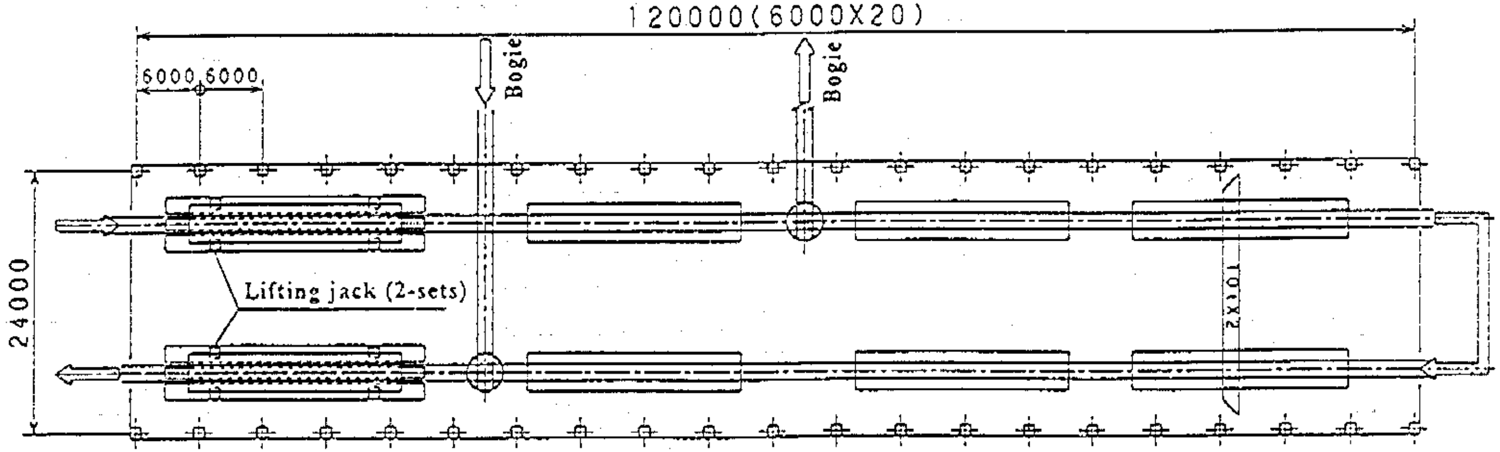


Appendix 11.2.1 Fig 1 Arrangement Plan of Locomotives

Plan of inspection / repairing shed for EC (Overhead travelling crane)   Body 20m (L) x 3.5m (W)

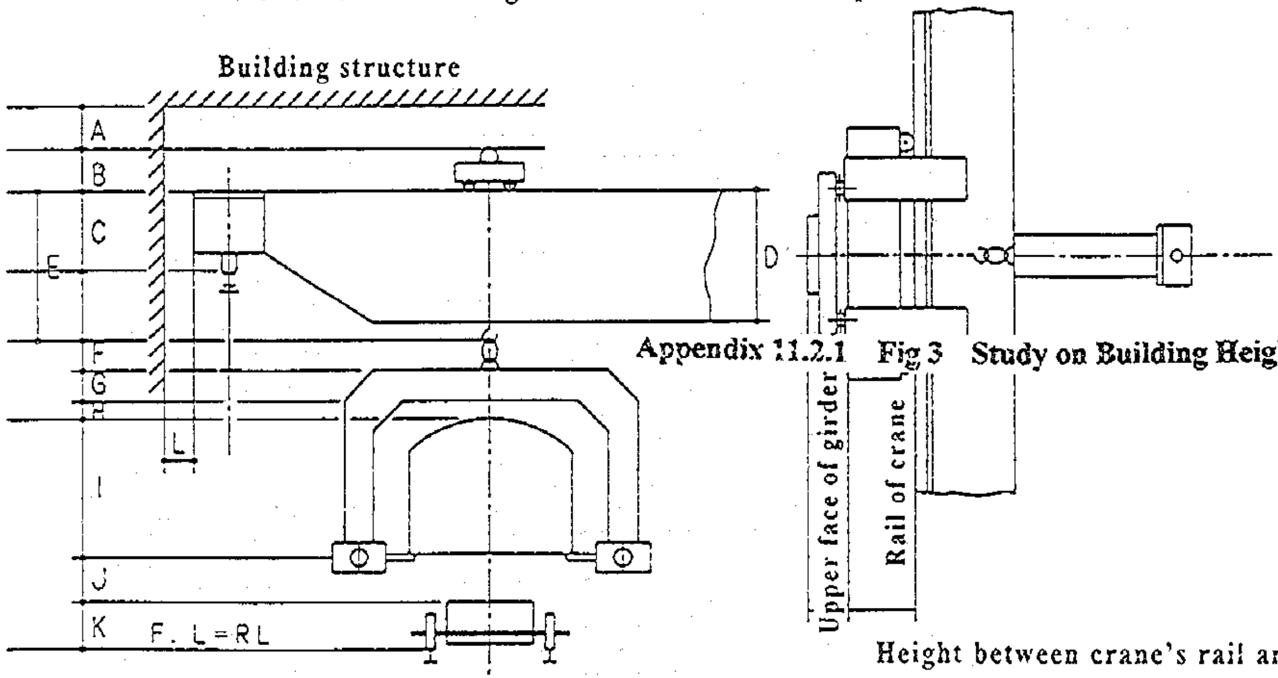


Plan of inspection /repairing shed for EC (Lifting jack)



Appendix 11.2.1 Fig 2 Arrangement Plan of car-body

Overhead travelling crane 20t x 22500mm span



A:	400 or more	F:	500	K:	1,500
B:	1,500	G:	500	L:	400 or more
C:	550	H:	800		
D:	1,000	I:	4,200		
E:	1,200	J:	1,000		

Height between crane's rail and lower part of building

= A+B+C

= 400 + 1,500 + 550 =2,450 mm or more

Height between crane's rail and F.L.(R.L.)

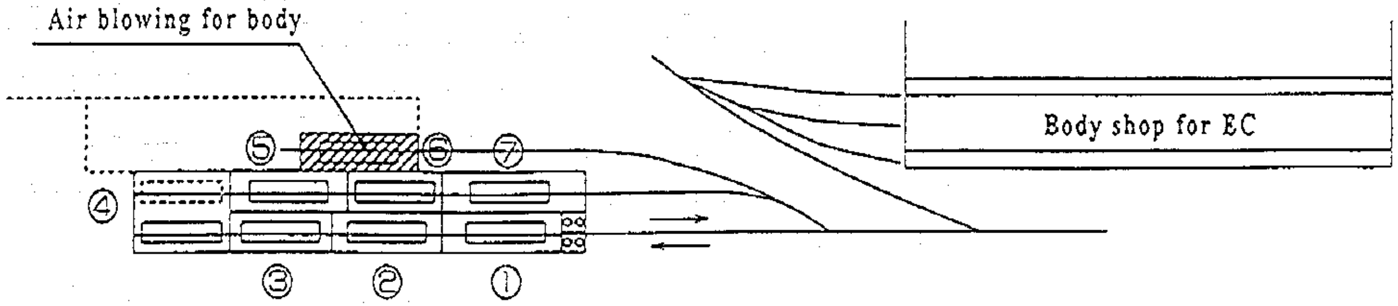
= E-C+F+G+H+I+J+K

= 1,200 - 550 + 500 + 500+ 800

+ 4,200 + 1,000 + 1,500=9,150 mm

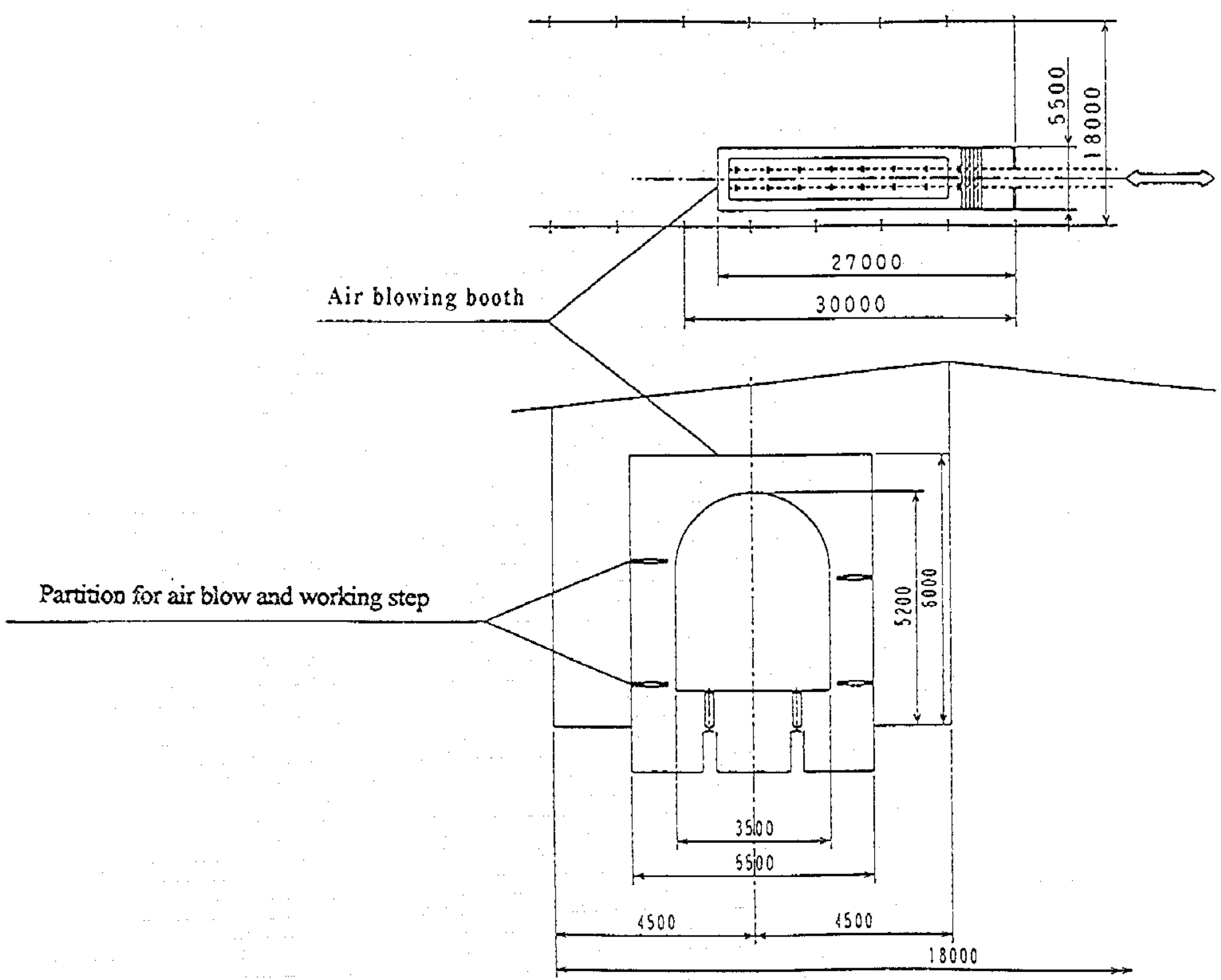
Height of building = 2,450 + 9,150=11,600 mm

Appendix 11.2.1 Fig 3 Study on Building Height of Car body Shop

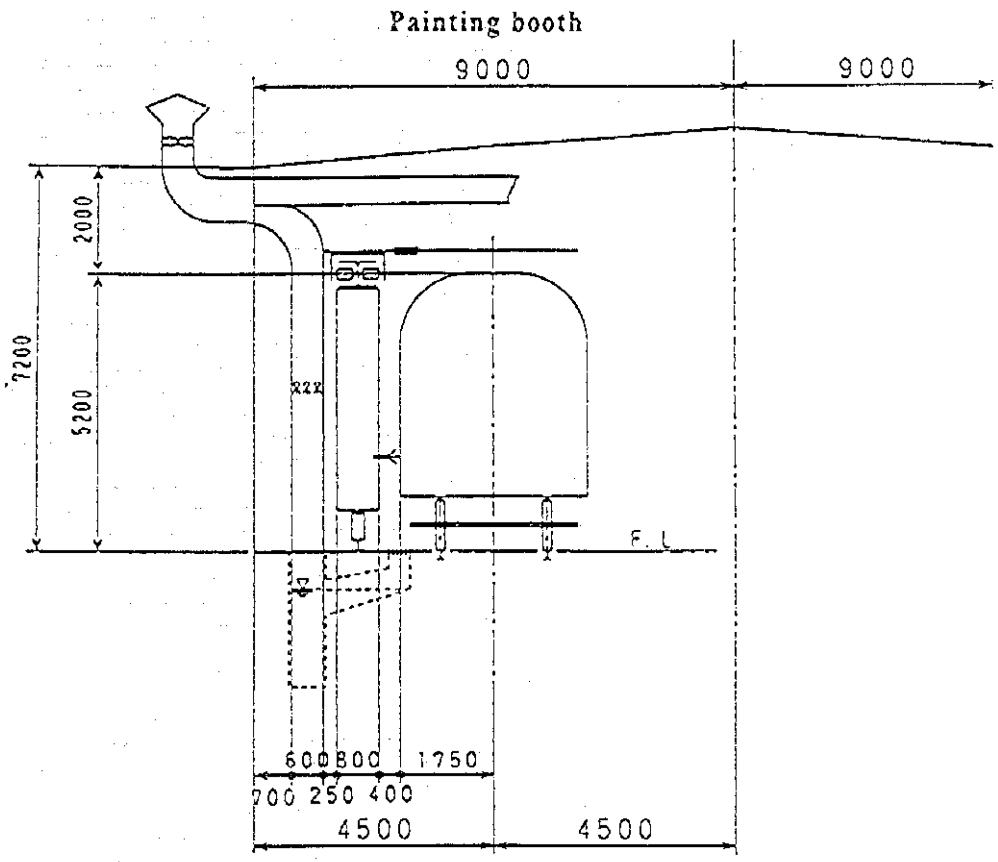


First step of Tact system	① Machine cleaning of body-side
	Cleaning of front/ear of body by manual work
	Preparation for painting
Second step of Tact system	② First painting
	③ Drying
Third step of Tact system	④ Preparation for painting
	Traversing of body
	⑤ Second painting
Fourth step of Tact system	⑥ Drying
	⑦ Marking

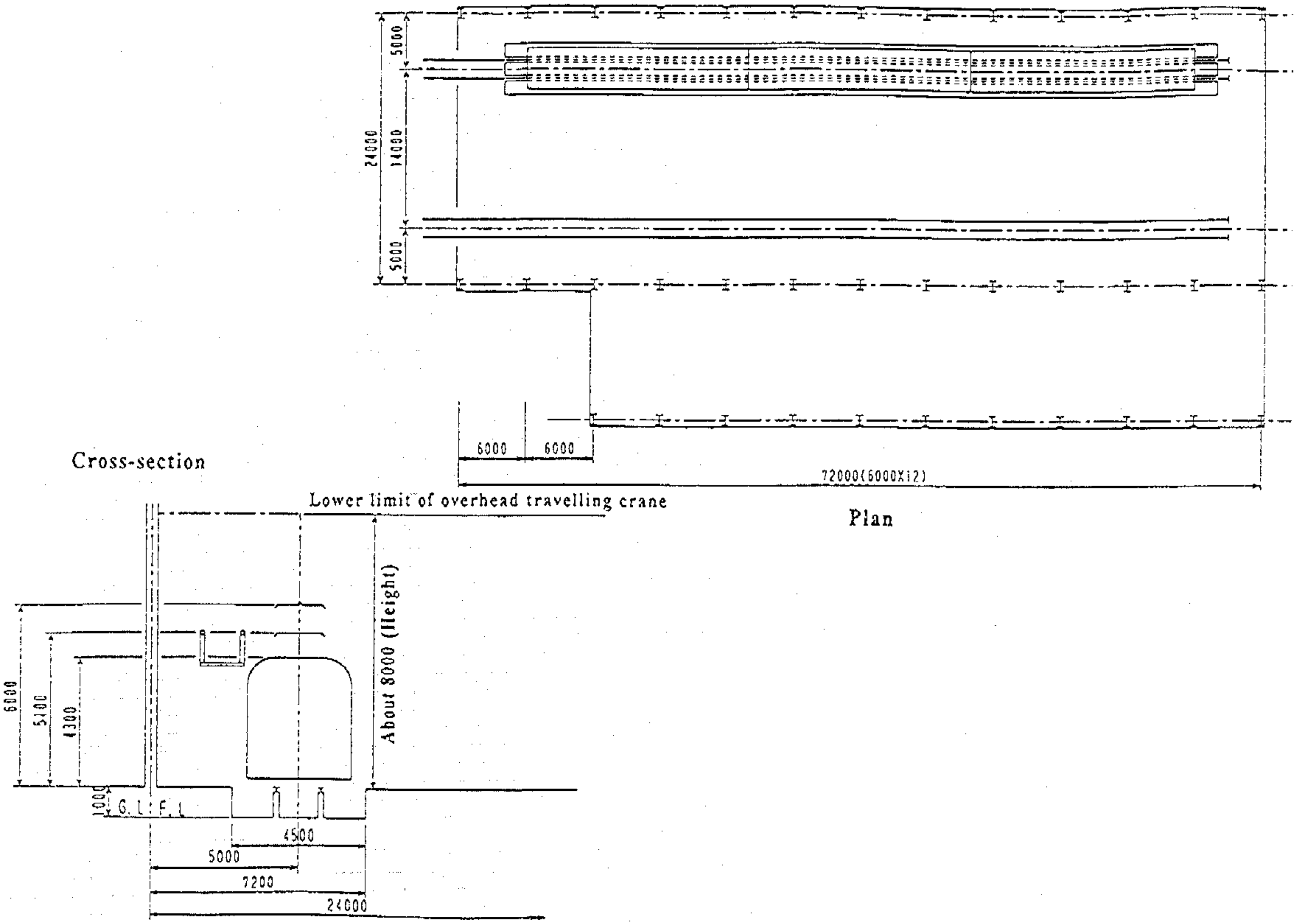
Appendix 11.2.1 Fig 4 Blowing / Painting Shed and Sequence of Painting Work



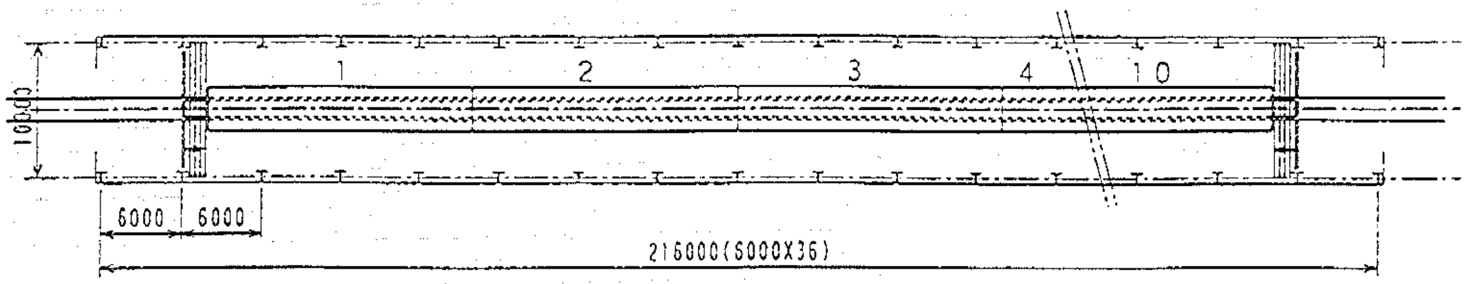
Appendix 11.2.1 Fig 5 Study on Air Blowing Shed for EC



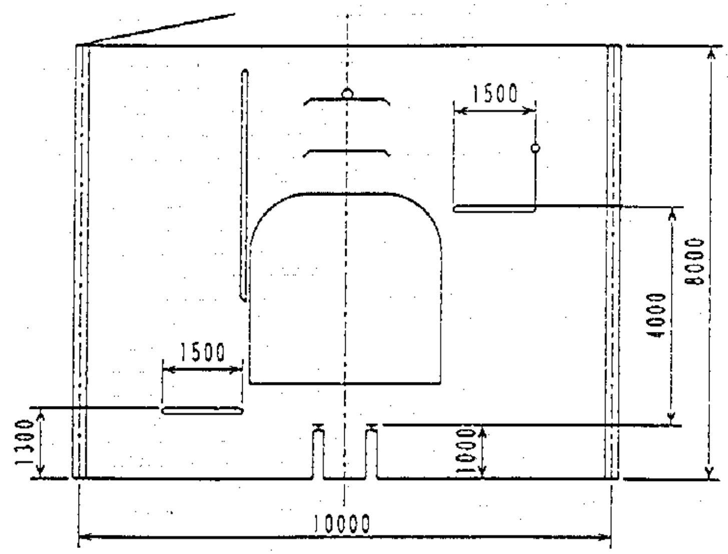
Appendix 11.2.1 Fig 6 Study on Painting Facilities



Appendix 11.2.1 Fig 7 Study on Final Inspection Shed for EL



Plan



Cross-section

Appendix 11.2.1 Fig 8 Study on In-coming/Final Inspection Shed for EC

Appendix 11.2.3-1 Reduction Method of Wastewater in Plating shop

Appendix 11.2.3-1 Reduction Method of Waste and Wastewater in Plating Shop

Electroplating wastes predominantly include spent process baths and rinse water contaminated by drag-out. Most of the wastes contained in drag-out (e.g., heavy metals, organic compounds, cyanide) are toxic and must be converted to some less hazardous form (e.g., chemical/physical processes). A typical electroplating process is shown in Fig. 1 of Appendix 11.2.3-1. Plated workpieces are rinsed with water, water used in this rinse process is physico-chemically treated and this process produces sludge (including heavy metals) and wastewater, which is one of causes which deteriorate the environmental condition.

The problem of the reduction of pollution loads produced by the electroplating industry represents one of the most classical and also most studied cases concerning attempts to apply technique for the recovery of metals from wastes. Electroplating waste can be minimized by the following methods:

- perfecting various operating practices;
- optimizing rinse system (improving efficiency); and
- modifying process and equipment.

In general, when there is reduction in waste generation, reduction in wastewater quality is also observed. Changing operation practices and improving rinse efficiency tend to be less costly and should be implemented prior to considering modification of process and equipment. The following aspects should be considered:

- reducing loss of metals and chemicals;
- minimizing or reducing drag-out chemicals;
- conserving water;
- recirculation rinse water; and
- increasing recyclability of unavoidable waste.

Considering the reduction in waste generation, one example is shown in Fig. 2 of Appendix 11.2.3-1. Water which is used in the rinse process is separated two parts, a concentrated water and a diluted water with the reverse osmosis treatment. If the former is recyclable, this concentrated solution is reused in the electroplating process, but if not, metals are recovered with electrolysis. The latter is reused as a rinse water.

Another example is shown in Fig. 3 of Appendix 11.2.3-1. This electroplating process includes:

- increasing the number of rinse baths;
- removing contaminants from plating and rinse baths; and
- distilling rinse solution to separate into a concentrated solution and water

Increasing the number of rinse baths reduces the waste and wastewater to be treated, and contaminants produced in the processes are removed from plating and rinse baths, which make plating and rinse baths reusable. Furthermore, the distillation separates the used rinse solution into a concentrated solution and water. The former is reused in the electroplating bath, and the latter is reused as a rinse water.

In the process of alkali cleansing for workpieces, the same consideration is useful.

A summary is:

(1) Increasing the number of rinse baths reduces the consumption of water, and the production of wastewater and wastes.

(2) Removing contaminants from plating and rinse baths to make plating and rinse baths reusable.
1) Oil skimming: Oil and grease are removed.
2) Filtration: Contaminants removal from plating baths.
3) Microfiltration and Ultrafiltration: This is a dynamic mechanical filtering process performed by means of membranes which allow selective separation, purification and concentration of organic substance of high molecular weight. Small particles (of the order of a micron), such as those produced by metal surface working can be separated. Some of the fields of application of microfiltration and ultrafiltration in the purification of industrial outflows are:

- oily emulsion;
- outflow water from metal finishing treatments;
- outflow water containing high concentration of tensionactives; and
- outflow water from painting plants.

(3) Concentrating used rinse solution to make it reused in the electroplating process
1) Distillation: Distillation is a simple and reliable process which is widely applied. It is the best process for chrome-plating. In general, the evaporation gives rise to a condensate containing traces of metals, which, however, can be used for the final rinse while the concentrate may be recycled for the metal-finishing bath. Many types of evaporator are available on the market, generally intended for the recovery of chrome. Vacuum concentrators, powered by electricity which, by means of cooling circuit working as heat pump, can concentrate water solutions with various concentration ratios

depending on needs, are particularly suitable. The advantages of these concentrators are:

- extreme compactness;
- low energy consumption;
- no fumes, smells, noises and vibrations;
- low maintenance; and
- possibility of treating thermolabile substances, thanks to the low operating temperature.

2) Reverse osmosis: The reverse osmosis is the separation of a component of a solution from another component of the same solution by means of a pressure exerted on a semipermeable membrane. The porosity of the membranes used for reverse osmosis may vary from 5 to 250 Angstrom; up to 99% of salts may be removed. The reverse osmosis treatment can be applied in the following main sectors:

- treatment of outflows containing colorings with their possible recovery;
- treatment of outflows containing oily emulsions, latex and electrophoretic paints; and
- treatment of metal salts and reuse of the water in cleaning.

The concentrated solution can be reused in the electroplating process and the purified water can be also used in the rinse process.

3) Electrodialysis: This is a process in which electrically charged membranes are used to separate ions from water solutions by the effect of a difference of electric potential.

4) Electrolysis: Recovery of metal content.

5) Solvent Extraction: Solvent extraction has all the characteristics to allow efficient recovery of metals from sludge mixtures or solutions, also because it is possible to recover the single metals, although up to now the costs are higher than the value of the metals recovered. Its greatest possibilities of application are in the selective separation of metals, by the formation of metal compounds which can dissolve in an organic phase. Specific chelating agents are normally used to extract the metal (Cd, Cr, Cu, Ni and Zn) in the organic phase. Experience has shown that there are various metal-chelation compounds, many of which dissolve in organic solvent. As in general the chelating compounds are much more expensive than the metals to be recovered, it must be possible to recycle the chelating material.

6) Chelating resins: Chelating resins selectively adsorb heavy metal ions from aqueous solutions.

(4) Removing Neutral Salts: Used alkaline or acidic aqueous solution is neutralized under relatively

high concentration and the neutral salts are recovered from the neutralized aqueous solution with solar energy, because the salinization of the surface water system is one of the most important environmental problems in Uzbekistan.

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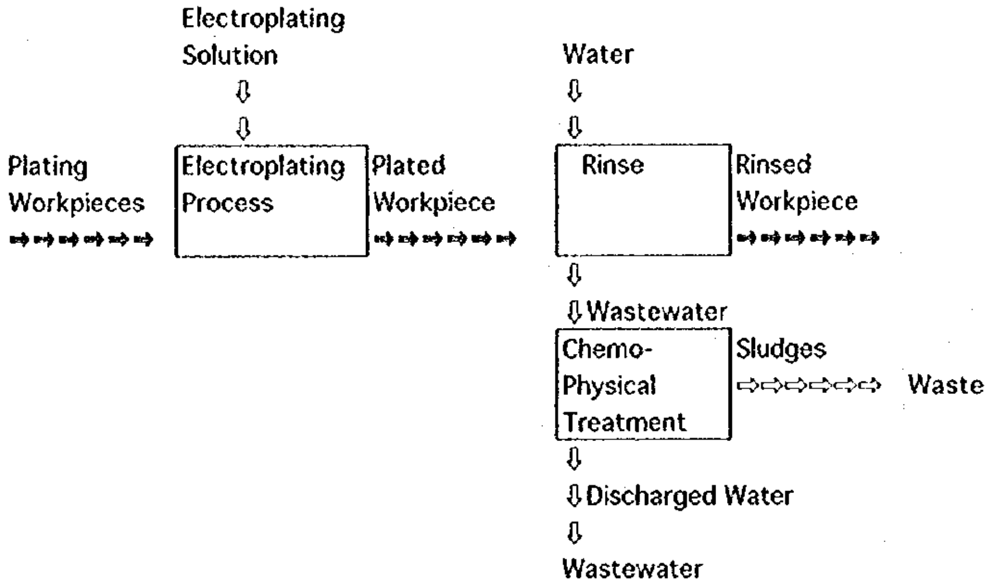


Fig.1 Typical Plating Process (Source: M. Pizzichini,"Membrane Technology:Applications to Industrial Wastewater Treatment (Hazardous Waste Reduction in the Metal-Finishing Industry)",1995, Kluwer Academic Publishers)

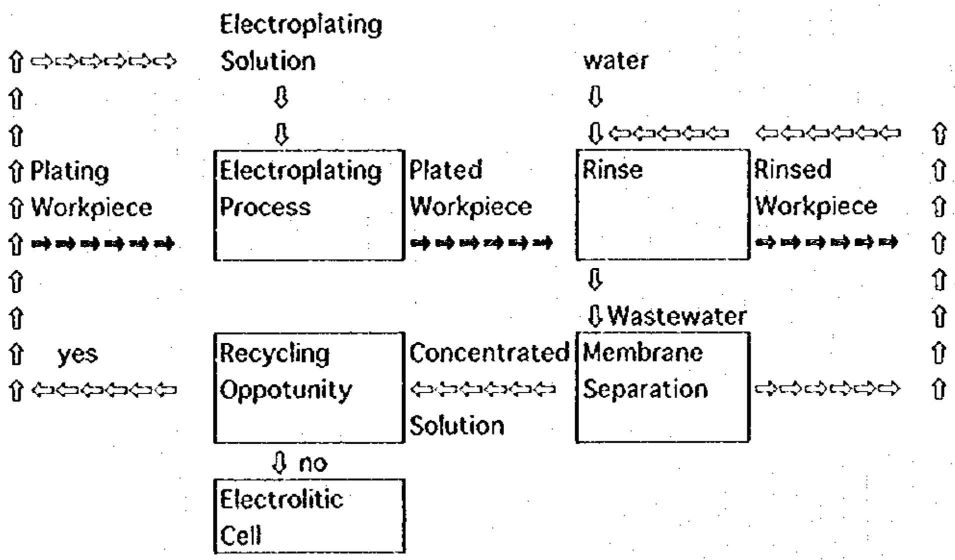
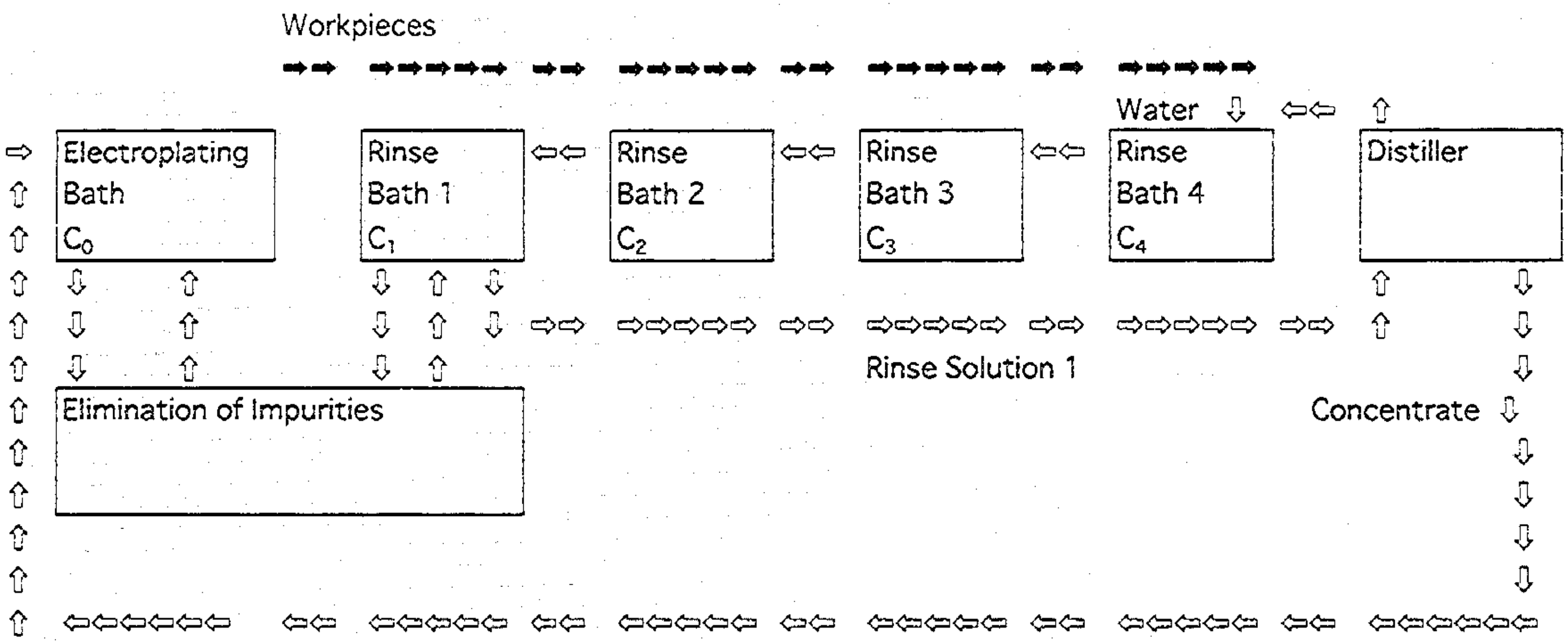


Fig.2 Plating Process Including Reuse (Source: M. Pizzichini,"Membrane Technology: Applications to Industrial Wastewater Treatment (Hazardous Waste Reduction in the Metal-Finishing Industry)",1995, Kluwer Academic Publishers)



Concentration of Bath Solution	C_0 : 100g/l
	C_1 : 10g/l
	C_2 : 1g/l
	C_3 : 0.1g/l
	C_4 : 0.01g/l

Fig.3 Plating Process Including Multi-rinse, Elimination of Impurities and Distillation

Appendix 11.2.3.2 A Treatment System for the Wastewater Containing Oil Products in Japanese Locomotive Repair Workshop

Appendix 11.2.3-2 A Treatment System for the Wastewater Containing Oil Products in Japanese Locomotive Repair Workshop

The treatment system for the wastewater containing oil products in Japanese locomotive repair workshop (Fig.1 of Appendix 11.2.3-2) consists of three parts:

- Preliminary oil separation;
- Physicochemical purification; and
- Sludge treatment.

(1) Preliminary oil separation

Wastewater enters a collecting tank through a screen, which removes coarse and settleable solids. Rain water is temporarily stored in a storage tank. These different types of water is mixed in a preliminary oil separator to adjust the water quantity and quality, and then oil separation can be carried out by natural gravity. The first purpose is to eliminate floating hydrocarbon and a fraction of mechanical emulsion of hydrocarbon. The resulting water must be sufficiently oil-free to perform physicochemical purification with economical amounts of reagents. Depending on how fine the existing emulsions are, the resulting levels of insoluble hydrocarbon may in fact vary from 20 to 150-200 mg/l.

(2) Physicochemical purification

The wastewater treated in the preliminary separator is sent into a coagulation tank, where the wastewater is pH-adjusted with sulfuric acid or sodium hydroxide aqueous solution and is treated with inorganic coagulants and/or polymer coagulants. These chemicals are commonly used to aid the flotation process, and function to create a surface or a structure that can easily absorb or entrap air bubbles. Inorganic chemicals, such as the aluminum and ferric salts and activated silica, can be used to bind the particulate matter and the oil products together and, in so doing, create a structure that can easily entrap air bubbles. Various organic polymers can be used to change the nature of either the air-liquid interface or the solid-liquid interface or both.

Oil products and particulate matters, which are coagulated in the coagulation tank with coagulants, are sent into a dissolved air flotation tank. Flotation is a unit operation used to separate solid or liquid particles from a liquid phase. Separation is brought about by introducing fine gas (usually air) bubbles into the liquid phase. The bubbles attach to the particulate matter, and the buoyant force of the combined particle and gas bubbles is great enough to cause the particle to rise to the surface.

Particles that have a higher density than the liquid can thus be made to rise. The rising of particles with lower density than the liquid can also be facilitated (e.g., oil suspension in water).

In dissolved-air flotation (DAF) systems, air is dissolved in the wastewater under a pressure of several atmospheres, followed by release of the pressure to the atmospheric level. A portion of the DAF effluent (15% to 20%) is recycled, pressurized, and semi-saturated with air. The recycled flow is mixed with the unpressurized main stream just before admission to the flotation tank, with the result that the air comes out of solution in contact with particulate matter at the entrance to the tank. The particle with air rises on the surface of the flotation tank, and is recovered as a scum in a scum recovery tank. The treated wastewater is discharged.

(3) Sludge treatment

The recovered scum is stored, concentrated, and re-coagulated and dehydrated with polymer coagulants in a sludge tank. The sludge concentrated and dehydrated in the process of sludge treatment is sent into a rotary Kiln incinerator and incinerated. Water part produced in this process is returned into the coagulation tank.

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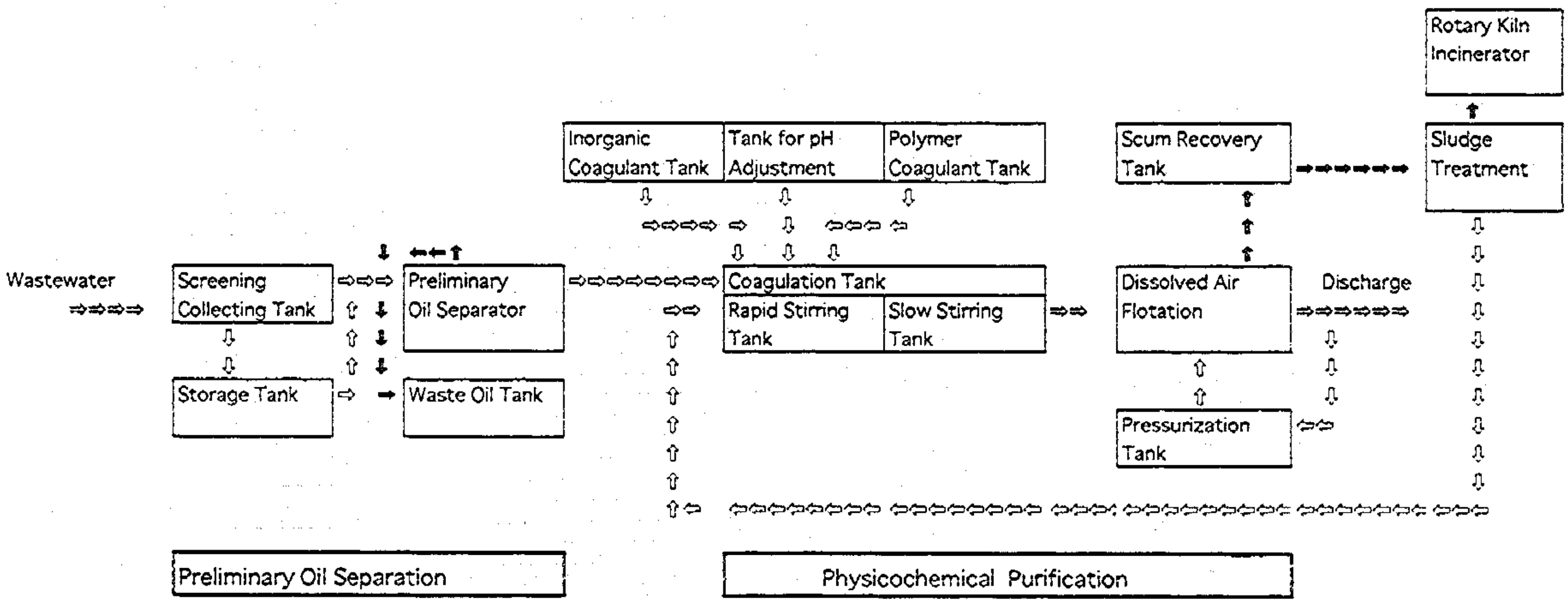

Fig. 1 A Treatment System for the Wastewater Containing Oil Products in Japanese Locomotive Repair Workshop

Appendix 11.2.3-3 Equipment for the Removal of Dust from Exhaust Gas

Appendix 11.2.3-3 Equipment for the Removal of Dusts from Exhaust Gas

The highest emission of particulate matter is caused by solid fuel furnaces due to the release of mineral fuel components. Except for few cases, even in large-scale industrial furnaces particle precipitators have not been installed either in oil furnaces operating with light fuel or in those operating with heavy fuel oil. There are several dry types of equipment for the removal of dusts from flue gases as follows:

- Gravity settling chamber
- Inertial particle collectors;
- Filters; and
- Electrostatic precipitators.

which are possible for dry collection and disposal.

(1) Gravity Settling Chamber

The gravity settling chamber is shown in Fig. 1.1 of Appendix 11.2.3-3. The gravity-type collection device depends solely on the gravitational pull on the particle to collect the dust. The separator consists of a housing and hopper in which the velocity of the gas stream is made to drop rapidly below the transport velocity of the dust particle. The velocity reduction is accomplished by the sudden expansion into the enlarged housing.

The gravity settling chamber is usually of simple design and can be manufactured of almost any material, assuming that it is not affected by temperature. Maintenance is minimal, provided that corrosion control is maintained. Applications for gravity settling chambers are limited due to the large space requirements and relatively low efficiency.

(2) Inertial Particle Collectors

1) Multiple Baffle Chamber (shown in Fig.1.2 of Appendix 11.2.3-3)

Particulate matter can be separated from a gas by making use of their inherent forces of inertia. Obstacles are placed in the gas placed in the gas flow and divert it. Due to their mass inertia the particles carried along try to maintain their original direction. Thus, they either collide with the obstacles or reach area outside of the gas flow and are thus separated from the gas.

2) Cyclones

The gas is introduced tangentially into symmetrically rotating centrifugal separator, as shown in Fig. 1.3 of Appendix 11.2.3-3. Inside the cyclone, the gas swirls an immersed tube and the particulate is carried by inertia to the cylinder wall, from where they exit through the conical section on the bottom while the clean gas exits through the top. A cyclone alone is insufficient for the complete removal of particulate. Therefore it is used preliminary particulate removal.

(Advantages):
- Low cost of construction;
- Relatively simple equipment with few maintenance problems;
- Relatively low operation pressure drops;
- Temperature and pressure limitations imposed only by the materials of construction used; and
- Relatively small space requirements.

(Disadvantages):
- Relatively low overall particulate collection efficiencies, especially on particulate below 10μm in size; and
- Inability to handle tacky materials.

(3) Filters

Filters represent one of the oldest methods of removing particulate matter from a medium. Particularly in the recent past, with higher levels of removal of especially fine particles being increasingly required, filters have gained more and more importance. Filter materials are different types of fabrics or fleeces. Though fabric filters consisted of interwoven natural fibers, artificial fibers and fabrics made of fine metal threads have decidedly expanded the field of application of the fabric filter owing to their resistance against wearing and chemical influences.
The suitability of a fabric filter or fleece and its durability are determined by the operating temperature and the properties of the particles. Cotton can be used up to 80℃, wool or wool felt up to 110℃, polyacrylic nitride (orlon) or superpolyamide (nylon, perlon) up to 130℃. In addition, the two latter fabrics are almost nonreactive to moisture and chemical influences. For temperatures up to 260℃, glass fiber fabrics, e.g., are used.

For trouble-free operation moisture content and temperature of the gas must be within a certain limited range. If gas temperature falls below its dew point, clogging of the filter can ensue. Excessive gas temperature have an unfavorable effect on the durability of the fibers.

(Advantages):
- Extremely high collection efficiency on both coarse and fine particulate;
- Relatively insensitive to gas fluctuation;
- Filter outlet air may be recirculated within the plant in many cases;
- Corrosion and rusting of components are usually not problems;
- Use of selected fibrous or granular filter aids permits the high-efficiency collection of submicron smokes and gaseous contaminants;
- Filter collectors are available in a large number of configurations, resulting in a range of dimensions and inlet and outlet flange locations to suit installation requirements;
- Relatively simple operation;
(Disadvantages):
- Relative high maintenance requirements (bag replacement, etc.);
- Fabric life may be shortened at elevated temperatures and in the presence of acid or alkaline particulate or gas constituents;
- Hygroscopic materials, condensation of moisture, or tarry adhesive components may cause crusty caking or plugging of the fabric or require special additives;
- Replacement of fabric may require respiratory protection for maintenance personnel.

1) Tube Filters (shown in Fig. 2.1 of Appendix 11.2.3-3)

Depending on the performance required, a closed housing accommodates a number of filter tubes. The lower part of the housing functions as a hopper. During the filtering process dusty air enters it via the inlet. The coarse particles are immediately separated here and are removed with the already separated dust by a removing mechanism. Subsequently, the dirty air flows through filtering tubes, deposits the particles and leaves the collector, with the help of a fan, by the outlet. If the filtering layer becomes too thick and the pressure drop increases, the filter is shut down for cleansing. For this, the outlet is closed with a flap and pressurized air is blown in, washing out the tube in the opposite direction. Simultaneously, the tubes are vigorously rapped with the rapping mechanism, so that the filtrate layer falls off.

2) Baghouse Filters (shown in Fig. 2.2 of Appendix 11.2.3-3)

There is no difference between tube and frame filters in their basic mode of operation. The filtering elements consist of pillowcase-like bags pulled over tentering frames. The open slot on the one side is pulled over a flange and sealed. Filtering usually takes place from the outside to the inside. Cleaning is carried out by vibrating the frame or by alternating the air pressures to cause the filtering surfaces to flutter. During this, usually only the upper layers of the filter cake will fall off, so that the primary layer of dust with its favorable filtering properties is preserved. The timing for cleaning is regulated by automatic pressure drop controllers.

(4) Electrostatic Precipitators

The main characteristics of electrostatic precipitators is the movement of particulate onto the walls of removal surfaces by electrical force of a high-voltage field. The precipitator is indicated by a metallic tube in which a wire which is electrically insulated against this tube is axially installed. The inside of the grounded tube is the particle collection surface. The central wire electrode is negatively charged by the high-voltage plant. Apart from the tube-type electrostatic precipitator there is the much larger group of the plate-type collectors with plate-like collection electrodes (Fig. 3.1 of Appendix 11.2.3-3).
The particle removal in an electrostatic precipitator (in Fig 3.2 of Appendix 11.2.3-3) can be divided into four basic processes as follows:

- Charging of the particulate;
- Migration of the particles to the collecting electrode;
- Deposition of the particles on the collecting electrode; and
- Removing the collected particles into the storage hopper.

(Advantages):
- Extremely high particulate collection efficiencies can be attained;
- Low pressure drop;
- Relatively low operating costs;
- Capable of operation under high pressure or vacuum conditions; and
- Capable of high temperature.

(Disadvantages):
- High capital cost;
- Very sensitive to fluctuations in gas stream conditions;
- Relatively large space requirements required for installation;
- Explosion hazard when treating combustible gases and/or collecting combustible particulate;
- Special precautions are required to safeguard personnel from the high voltage;
- Ozone is produced by the negatively charged discharge electrode during gas ionization; and
- Relatively sophisticated maintenance personnel required.

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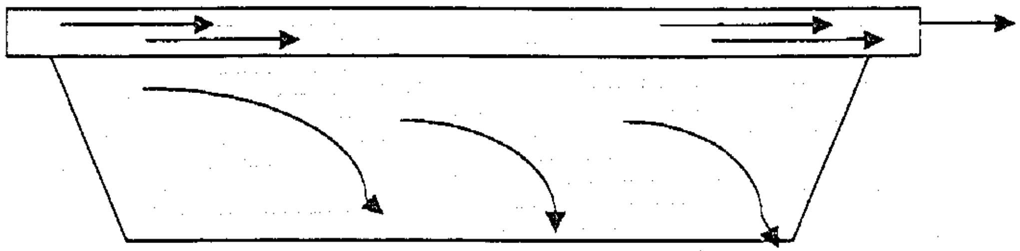

Fig.1.1 Gravity Setting Chamber

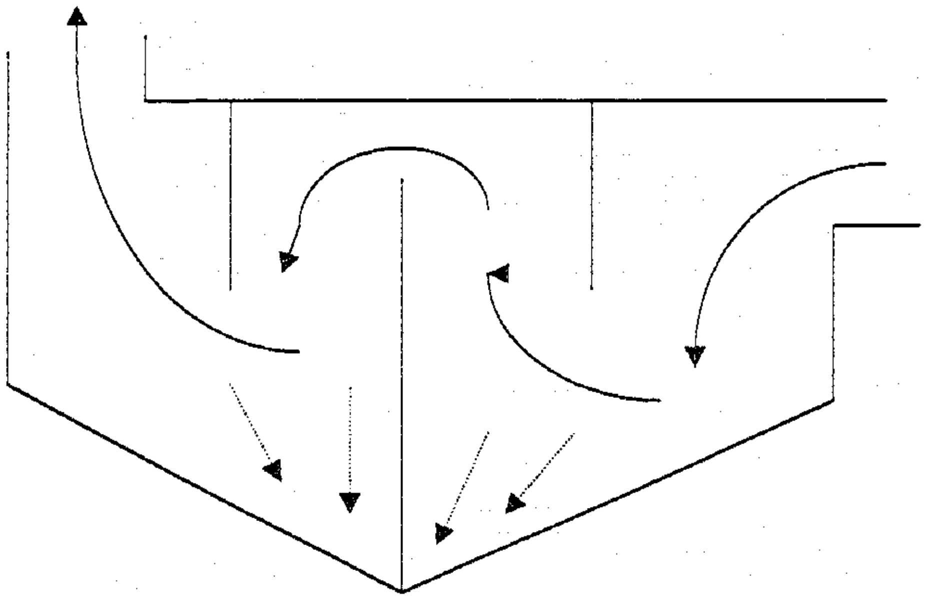

Fig. 1.2 Multiple Baffle Chamber

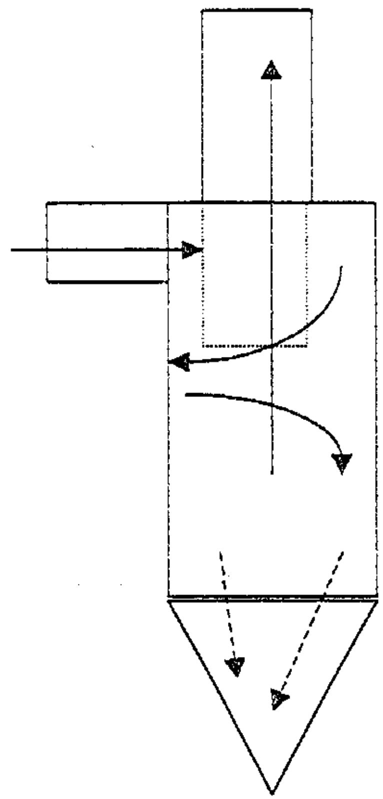

Fig.1.3Basic Cyclone Collector

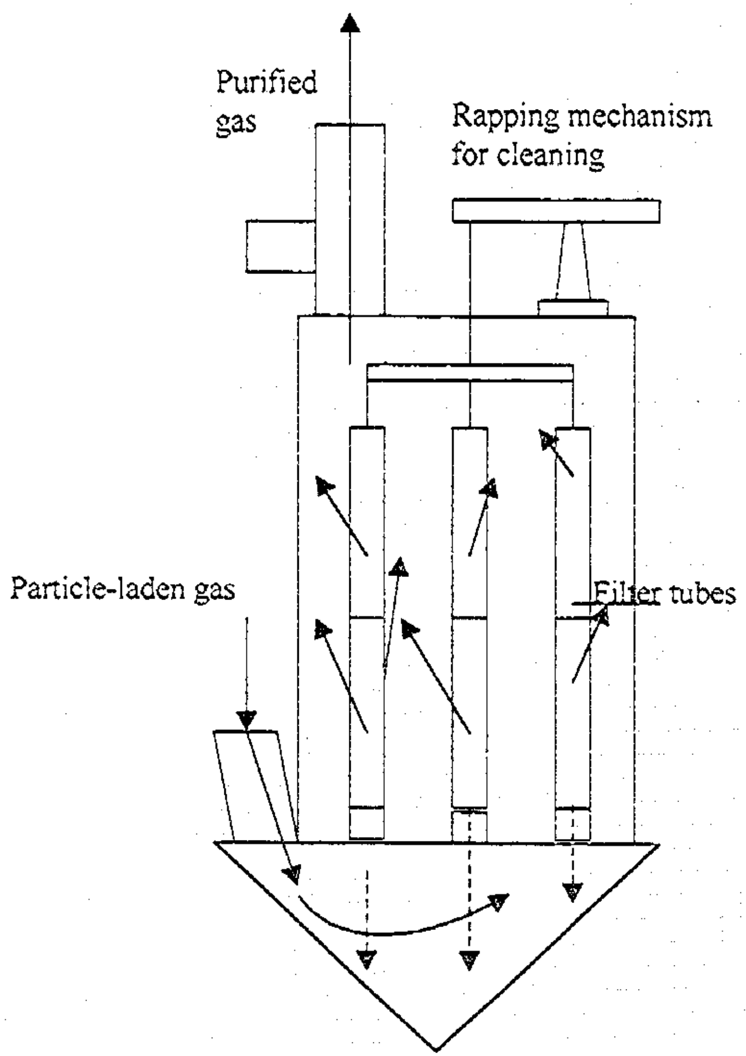

Fig.2.1 Tubular Bag Filter

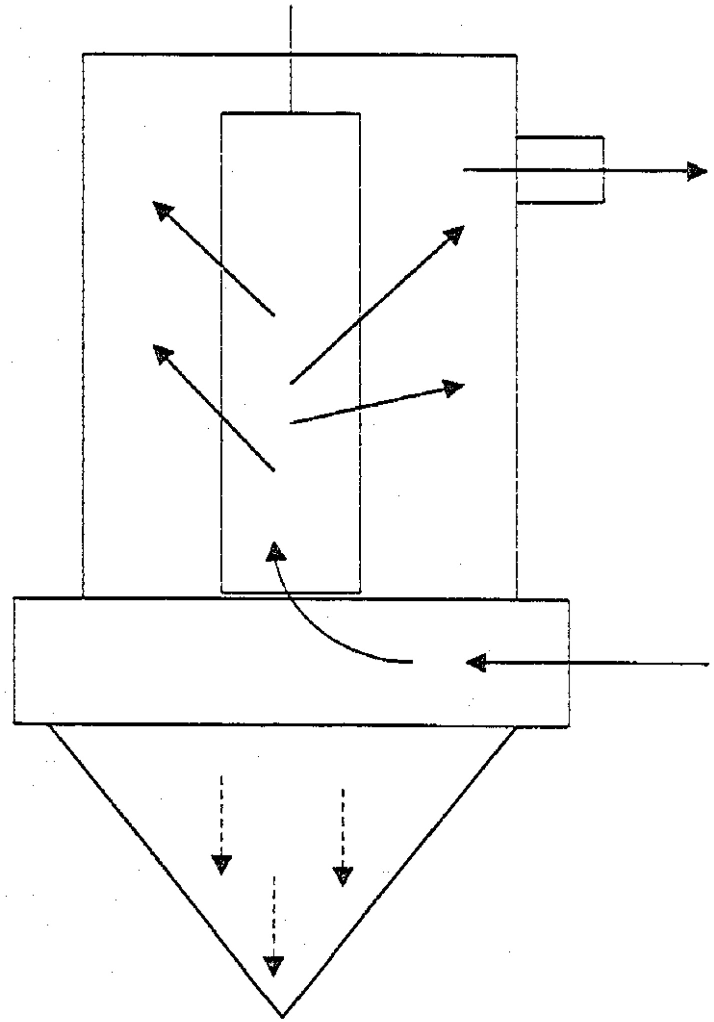

Fig.2.2 Baghouse Filter

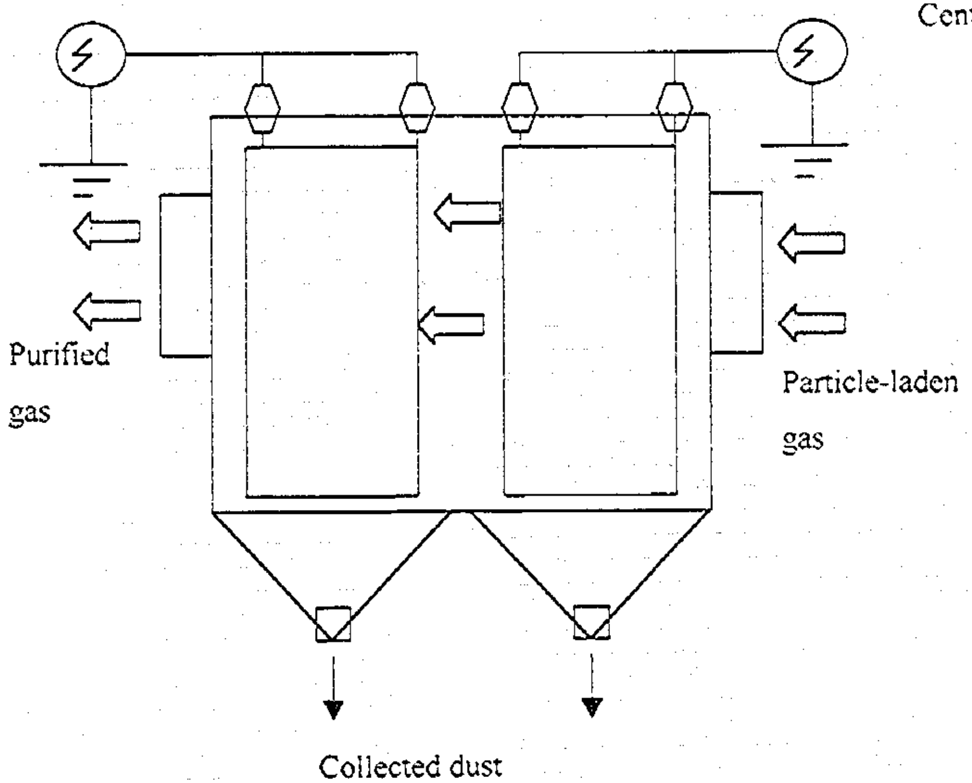

Fig.3.1 Electrostatic Precipitator

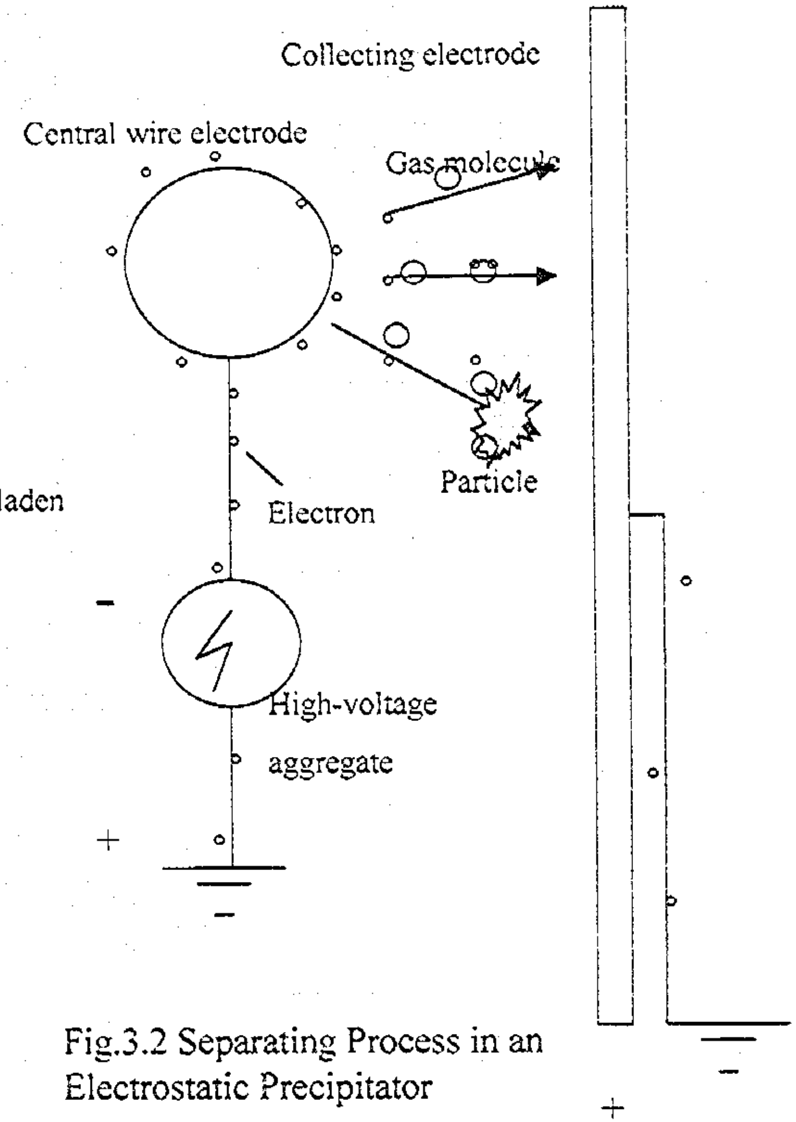

Fig.3.2 Separating Process in an Electrostatic Precipitator

Appendix 11.2.3-4 Wet Srubbers for the Removal of Dust and Gas Components from Exhaust Gas

Appendix 11.2.3-4 Wet scrubbers for the Removal of Dust and Gas Components from Exhaust Gas

The wet scrubber method is utilized for the removal of dust and gas components from exhaust gases, e.g., acid gas components as SO_2, solvent components as acetone, and solid components as dust. The removal of gas and solvent components is shown in Fig. 1.1, 1.2 and 1.3 of Appendix 11.2.3-4 (Absorbers):

- Co-current type: the exhaust gas stream and liquid flow in the same direction through the scrubber (Fig. 1.1);
- Countercurrent type: the exhaust gas flows vertically upward while the liquid flows downward in direct opposition (Fig. 1.2); and
- Cross-flow type: the exhaust gas flows horizontally through the packing while the liquid flows vertically downward (Fig. 1.3).

The packing increases the contact surface between the exhaust gas and the liquid in every type of wet scrubbers.

For an exhaust gas containing dusts, a countercurrent type and a cyclone type of wet scrubber are used, as shown in Fig. 2.1 and Fig.2.2 of Appendix 11.2.3-4, respectively. Other types of wet scrubber are:

- Moving-bed scrubbers: they incorporate a zone of movable packing where gas and liquid can mix intimately; and
- Orifice-type wet scrubbers: the gas stream comes into contact with a pool of liquid at the entrance to a constriction. Liquid is entrained and carried into the restriction, where greater liquid-particulate interaction occurs, resulting in a high frequency of particulate impact on the droplets. Upon leaving the restriction, most of water droplets are separated by gravity since the gas velocity is reduced from what it was in the restriction. Smaller droplets are subsequently removed by centrifugal force and impingement on baffles located in the upper part of the unit

(Advantages of wet scrubbers):

- No secondary dust sources;
- Relatively small space requirements;
- Ability to collect gases as well as particulate (especially "sticky" ones);

- Ability to handle high-temperature, high-humidity gas streams;
- Capital cost is low (if wastewater treatment system not required); and
- Ability to achieve high collection efficiencies on fine particulate (however, at the expense of pressure drop);

(Disadvantage of wet scrubbers):

- They may create waster disposal problem;
- Product is collected wet;
- Corrosion problems are more severe than with dry systems;
- Pressure drop and horsepower requirements may be high;
- Solids buildup at the wet-dry interface may be a problem; and
- Relatively high maintenance cost.

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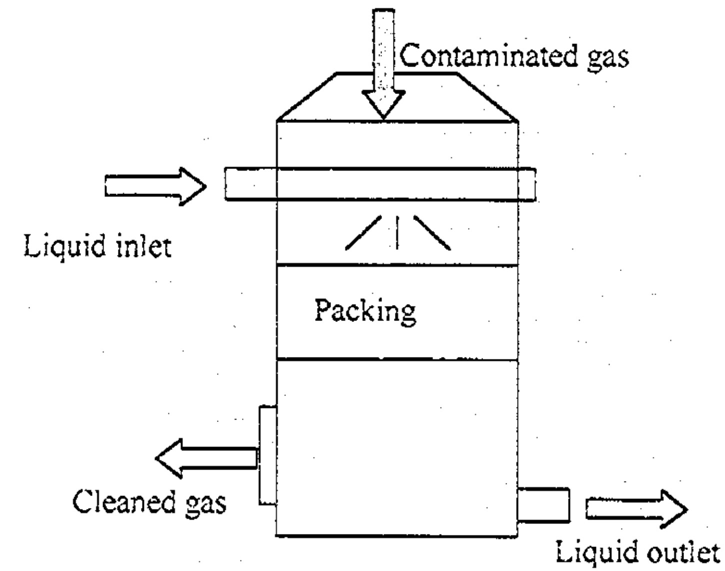

Fig. 1.1 Co-current Wet Scrubber

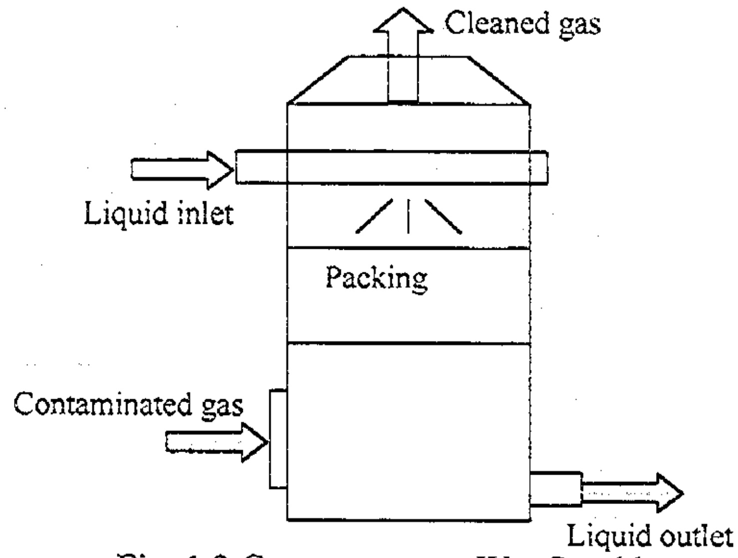

Fig. 1.2 Countercurrent Wet Scrubber

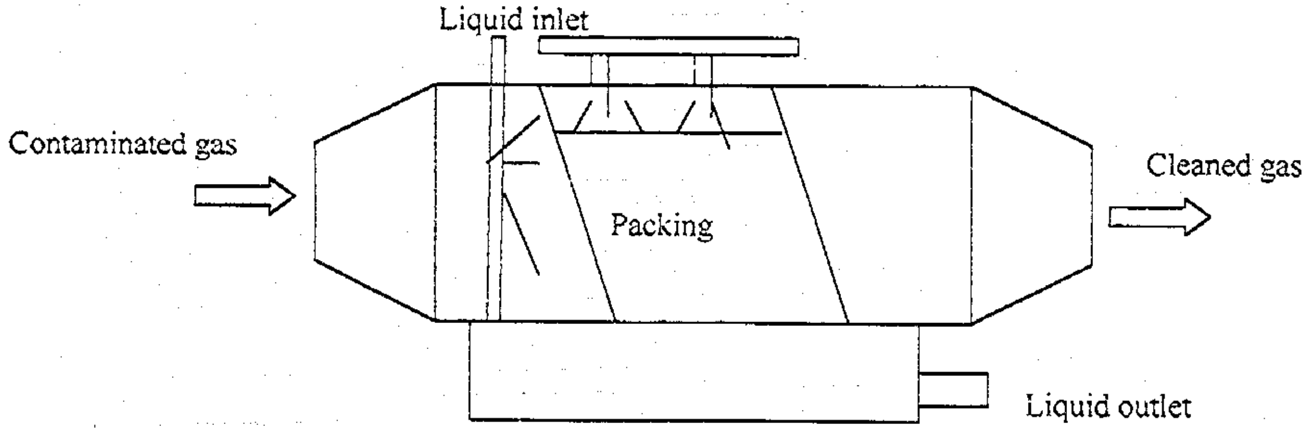

Fig. 1.3 Cross-flow Wet Scrubber

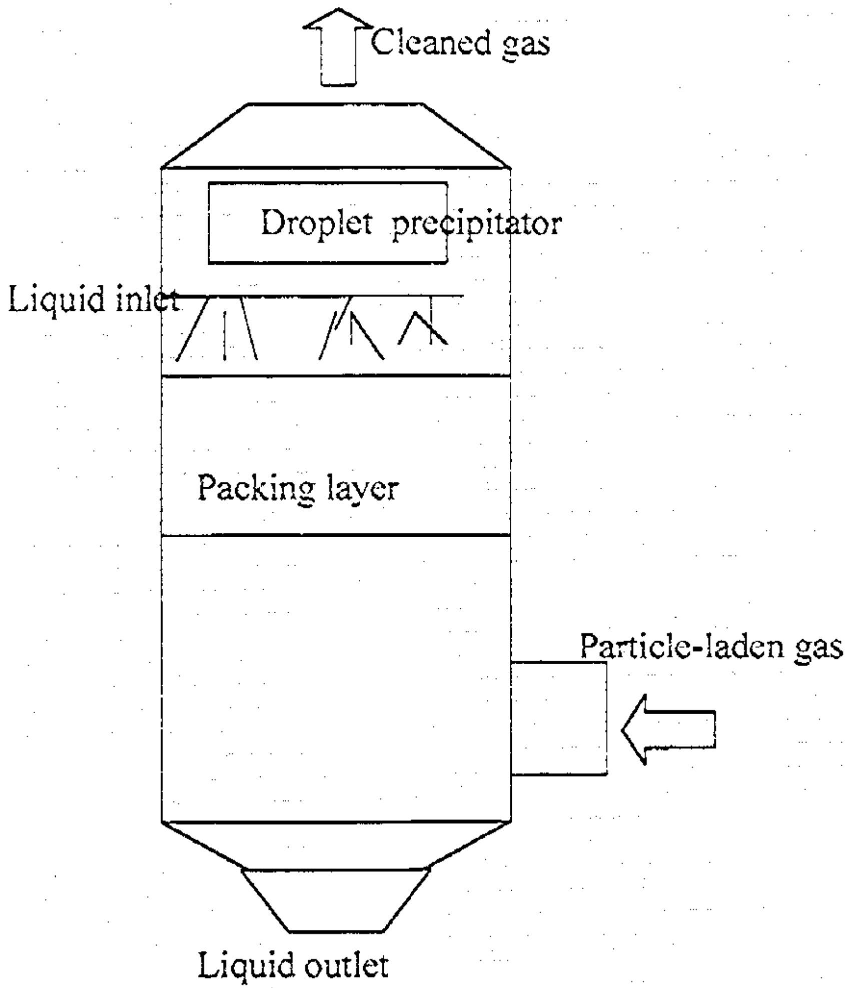

Fig. 2.1 Countercurrent Wet Scrubber for Flue Gas with Dust

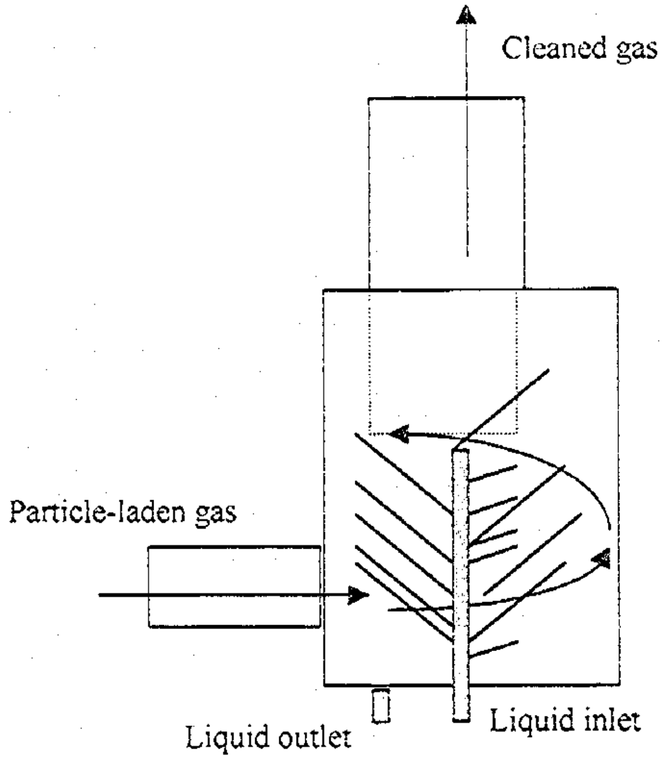

Fig. 2.2 Cyclone Scrubber

Appendix 11.2.3-5 Adsorber for the Removal of Gas Solvent Components from Exhaust gases

Appendix 11.2.3-5 Adsorber for the Removal of Gas and Solvent Components from Exhaust Gases

Two major categories of adsorber that presently manufactured for industrial and commercial use are air purification devices (nonregenerative) and solvent recovery devices (regenarative).

Air purification applications are effective where the pollutants are emitted at very low concentrations (below 100 ppm) but need to be controlled because of their highly malodorous or toxic nature. These systems are cost-effective only at low concentrations because of their nonregenerative design.

In solvent recovery applications, activated carbon may be used to economically recover and reclaim solvents from process exhaust streams at concentrations in the range of 100 to 1000 ppm.

Fig. 1.1 of Appendix 11.2.3-5 presents a flow diagram of a dual stational-bed solvent recovery system with auxiliaries for collecting the vapor-air mixture from various point sources, then transporting through the particulate filter and into the on-steam carbon adsorber, in this case bed 1. The effluent air, which is virtually free of vapors, is usually vented outdoors. The lower carbon adsorber (number 2) is regenerated during the service time of bed 1. A steam generator or other source of steam is required. The effluent steam-solvent mixture from the adsorber is directed through the condenser and the liquilified mixture then run into the decanter and/or distillation column for separation of the solvent from the steam condensate.

The type shown in Fig. 1.2 of Appendix 11.2.3-5 employs vertical cylindrical beds wherein the solvent-laden air flows axially down through the bed. Water is used as coolant in the condenser. Steam, electric power to drive the blower, and cooling water are three operation cost items.

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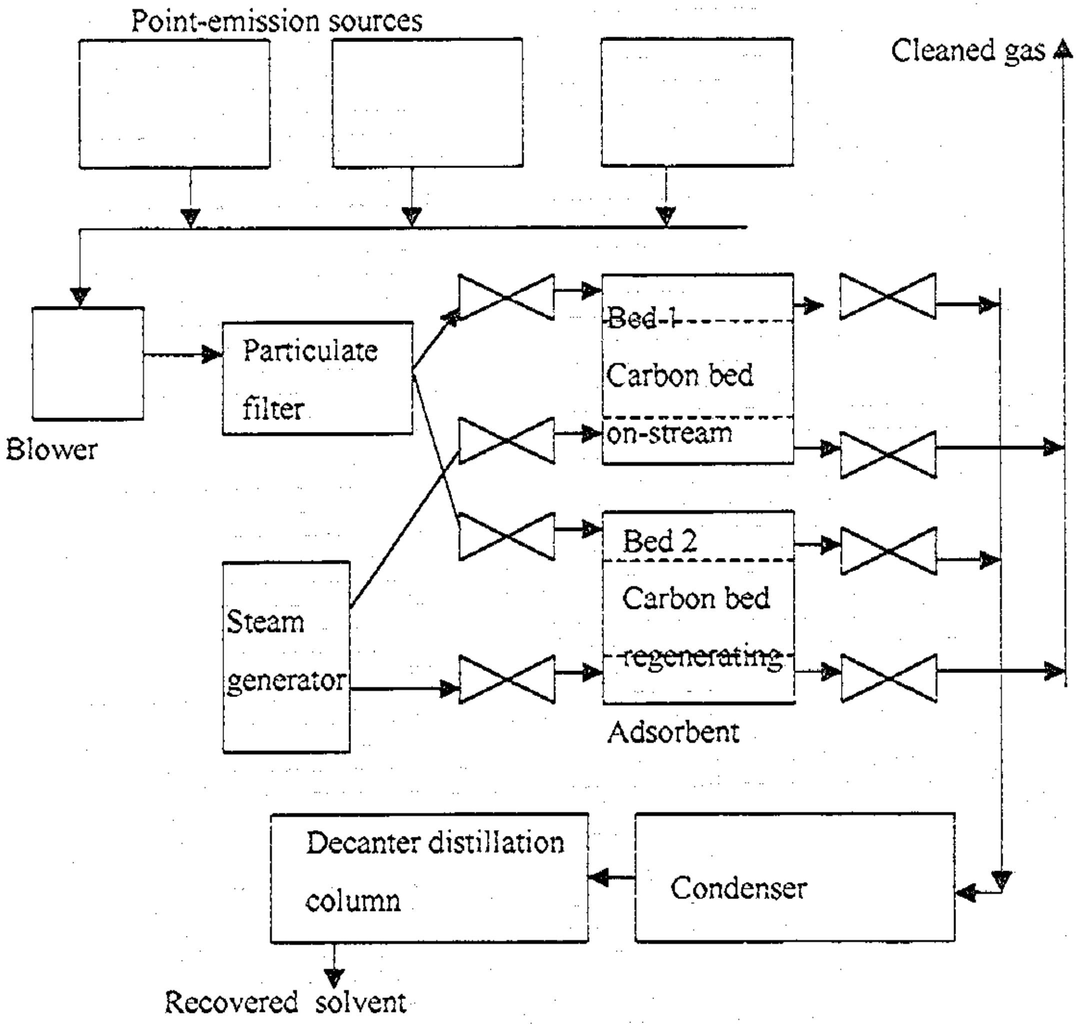

Fig. 1.1 Solvent Recovery System

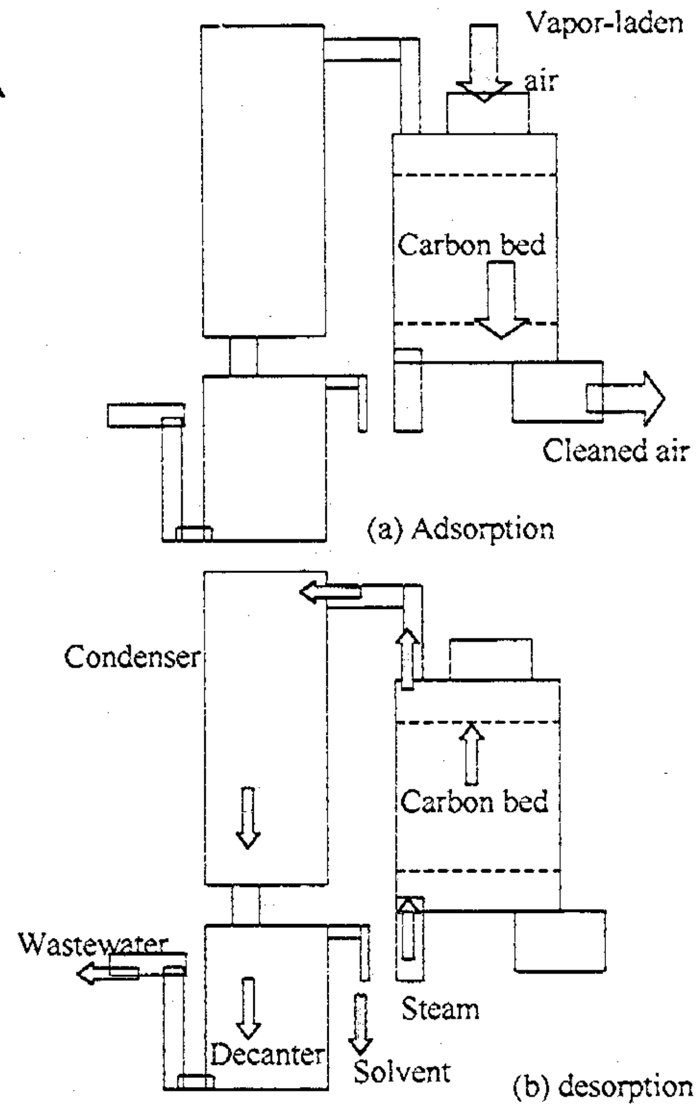

Fig. 1.2 Adsorber

Appendix 11.2.3-6 Removal of Dust and CO from the Flue Gas of Cupola and Electric Furnace

Appendix 11.2.3-6 Removal of Dusts and CO from the Flue Gas of Cupola and Electric Furnace

The removal of dusts from the flue gas of cupola is shown in Fig. 1 of Appendix 11.2.3-6. In this example, a cyclone type of dust collector is used. Appendix 11.2.3-3 describes on several types of dust collector. Waste streams consisting of baghouse dusts from cupola and electric furnaces that contain not only heavy metals such as zinc and lead but also flammable materials, can be returned to the cupola and electric furnaces. Because there are increasing levels of volatile lead and zinc in the dust, the efforts to recover these metals are also increasing. It is easily possible for up to 90% of the current quantities of dust to be processed for resource recovery.

The removal of dusts and CO from the electric furnace is shown in Fig. 2 of Appendix 11.2.3-6. Fume incinerators can be used to control the emission of gaseous or small-particulate air pollutants which are either combustible or which thermally decompose at high temperatures. Three rapid oxidation methods are used to destroy combustible contaminants:

- Thermal incineration;
- Catalytic incineration;
- Flares (direct flame combustion).

The main uses of fume incinerators are for the control of odor and smoke with some applications in hydrocarbon and carbon monoxide (CO) emission control.

Thermal incinerators are the most widely used method to control the release of hydrocarbon fumes, especially smokes and solvents from coating processes. Typically, thermal incinerator are constructed of a steel outer shell lined with refractory material. The refractory lining has purposes to protect the steel shell from direct exposure to the effects of high temperatures and corrosive materials, and also to improve the thermal efficiency of the unit by limiting heat loss. These incinerators are equipped with a burner at one end that fires a fuel, typically natural gas. There is also a fume inlet located near the burner where the gas stream to be oxidized enters the incinerator.

A catalytic incinerator is an alternative to a thermal incinerator as a means for oxidizing gaseous or oxygenated hydrocarbons to carbon dioxide and water. The oxidation reaction that occurs at the surface of the catalyst produces the same products, carbon dioxide and water, and liberates the same heat of combustion as a thermal incinerator would. A catalyst bed is located at a distance downstream from the burner sufficient to allow for a uniform preheated and distributed mixture of combustion products and waste gas stream. The catalyst bed in commercial units is typically a metal mesh mat, ceramic honeycomb, or other ceramic matrix structure with a surface coating of finely divided platinum or other platinum-family metals, such as chromium, vanadium, nickel, or cobalt.

The flare system is used primarily as a safe method for disposing of excess waste gases. All process plants that handle hydrocarbons, hydrogen, ammonia, hydrogen cyanide, or other toxic or dangerous gases are subjected to emergency conditions that require the immediate release of large volumes of such gases for protection of plant and personnel. Flares are used for this purpose.

After completely combustion of CO with a thermal incinerator or a catalytic incinerator in Fig. 2 of Appendix 11.2.3-6., the exhaust gas is cooled and passes through a electrostatic precipitator to remove dusts. The removal of dust is described in Appendix 11.2.3-3.

REFERENCE

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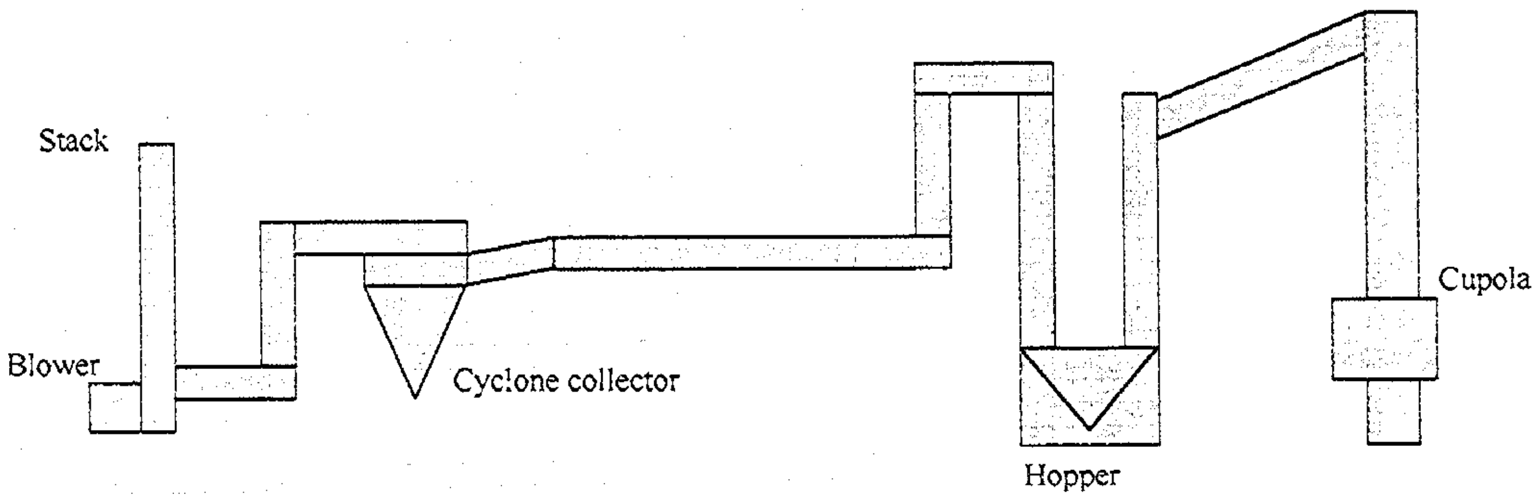

Fig. 1 Cupola with Cyclone Collector

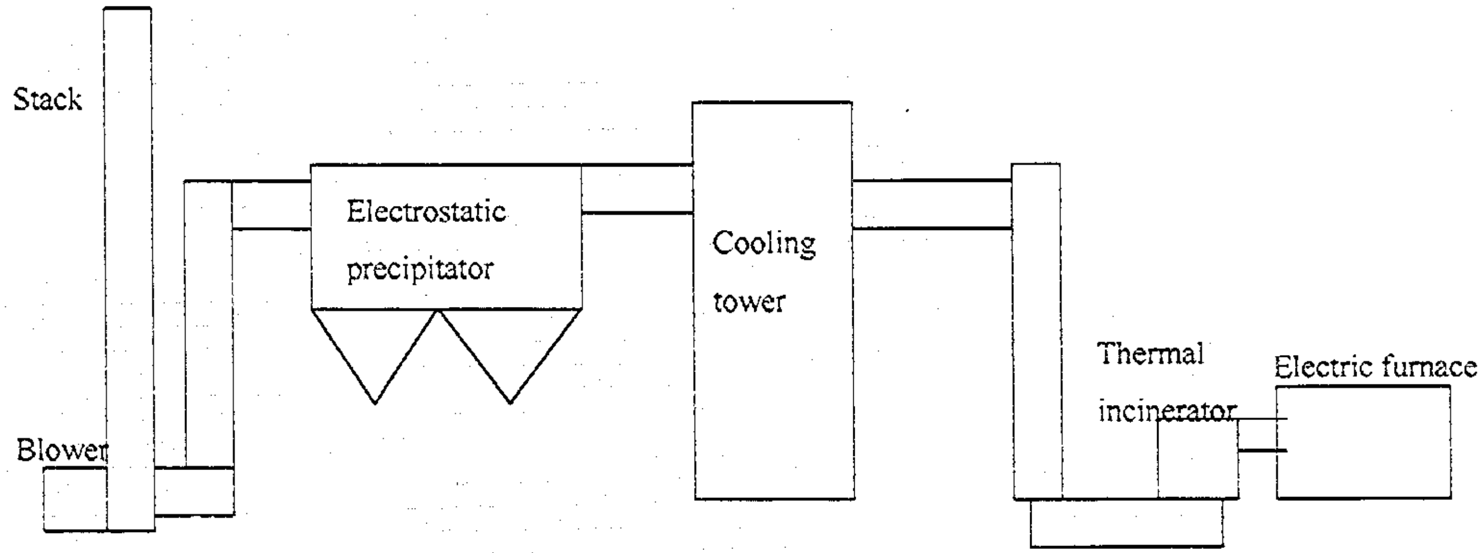

Fig. 2 Electric Furnace with Electric Precipitator

Appendix 11.2.3-7 Biological Methods for Reducing Wastes

Appendix 11.2.3-7 Biological Methods for Reducing Wastes

Biological methods for reducing wastes are classified into two following categories:

- Composting; and
- Anaerobic process.

(1) Composting

Composting is, just like landfilling and incineration, a classic method of waste treatment. It is an ecologically sound treatment method, because the organic share of the waste (generally about 40% by weight in household waste) is returned to the natural cycle. In comparison to other waste treatment methods, composting has only minor negative effects on the environment.

Waste which are to be composted must be primarily organic in nature and should have only minor contaminant concentrations. The most important compostable wastes in Tashkent Repair Workshop include:

- Biowaste (separately collected kitchen waste and green matter);
- Yard and park wastes.

The composting process has some very basic requirements. There must be adequate moisture, and the proper balance of carbon to nitrogen (C(weight)/N(weight) ratio, 25-30 to 1). These requirements can be easily managed to ensure a mature, uniform product. Other factors will influence composting and the rate at which it occurs, these are: nutrient supply, particle size, structural strength, frequency of turning (for aeration), acidity, and the size of the compost pile or heap.

There are three commonly practiced methods of composting: Bangalore, Indore, and Berkeley. The single outstanding difference between methods is the frequency of turning which affects the rate of decomposition.

Bangalore: The Bangalore method functions aerobically for several days and then becomes anaerobic, because no turning occurs. Although appropriate for both below- and above-ground composting it is more commonly carried out in pits. After 4 to 5 months the composting process is complete. One drawback with this methods is that without turning, the entire contents of pit do not reach high temperatures and not all pathogens and weed seeds are destroyed. Fly breeding and odor problems are often associated with this method so the top exposed portions must be covered, usually with soil. Material near the outside of the pit should not be used, but transferred and incorporated into the next composting.

Indore: The Indore composting system relies on aerobic activity although portions of the pile or pit will likely become anaerobic between turnings. This method has better fly control, more rapid and uniform decomposition, and less moisture control problems than with the Bangalore method. During the period of active composting the contents are turned from 1-5 times over a period of 1-6 months. The longer the interval between turnings the longer the composting process. Many smaller compost operations use this less labor intensive method.

Berkeley: The Berkeley method for composting is named after the University of California at Berkeley where it was developed. It is considered to be the quickest method of achieving finishing compost, and it is the method which is likely to be the most effective method for production of either large or small quantities of compost. This method requires frequent turning and mixing of the heap, particularly during the initial stages of decomposition which intensifies the activity of microorganisms. The Berkeley method is normally carried out in above-ground stacks or windrows where air circulation is improved and the pile is accessible for turning. Since turning is frequent, problems associated with odors and flies are minimal. Compost should be ready for maturing within two or three weeks depending on the size of heap, frequency of turning, initial C/N ratio, and moisture content. Labor requirements are higher with this method than the others, but the shorter composting period reduces the space needed for a site. Where large quantities of compost are produced a mechanized system is often used.

There are modernized composting methods, but the description on these methods are omitted here.

(2) Anaerobic Processes

Biogas facilities were originally used in agriculture for the treatment of animal waste. They were also used in sewage treatment plants for sludge stabilization and for cleaning highly contaminated wastewater. The organic fraction of household waste (if it was biologically treated at all), was treated aerobically, i.e., it was composted. By the early 1980s, after sewage treatment had progressed sufficiently with the development of highly efficient digesters, biogas plants were increasingly used for the treatment of solid and sludgy organic wastes. The expectations were that fermentation would require less space, emit no odors, yield energy, and offer flexibility in its application.

The composting of organic production wastes (mostly in the food processing and beverage industry) is not feasible because of the high water content and the large space requirements. Incineration would lead to a significant reduction of volume, but would require considerable technical effort and energy input. Thus, in-house anaerobic digestion is as an economical solution for companies, because of the minimal space requirements and the volume reduction it offers, while at the same time generating energy for the operator.

In nature, methane-forming bacteria are found whether biogenic-organic material is decomposed in oxygen-deficient environments, e.g., in swamps and sediments, and also in the stomachs of ruminants. The methane-forming bacteria, called obligate anaerobes, can only survive in an environment without oxygen. Since the energy yield without oxygen during substrate decomposition is only 1/7 that of aerobic bacteria, anaerobes multiply at a corresponding slower rate. In their metabolism, they are dependent on the preparatory work of and the symbiosis with other bacteria.

In the first phase, high-molecular compounds such as carbohydrates, fats and proteins react with water to form sugar, fatty acids, and amino acids. This stage is called hydrolysis. In the next phase of acid formation, the compounds are fermented by acid forming bacteria into propionic and butyric acids, hydrogen and carbon dioxide as well as lower alcohols. These groups of bacteria form a symbiotic relationship, because the acetogenic bacteria are inhibited by their own product, hydrogen, and depend on the methane-forming bacteria to detoxify their environment. Based on this symbiosis, the two combined steps of acetic acid formation and methane formation are the third phase, called methane fermentation phase. Since the energy yield of methane-forming bacteria is very low and causes them to multiply very slowly, the limiting factor for the rate of anaerobic decomposition is the forming of methane.

Equipment of anaerobic processes for reduce wastes are omitted here.

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2. Joan H. Miller and Norman Jones, "Organic and Compost-Based Growing Media for Tree Seedling Nurseries" (1995), World Bank Technical Paper Number 264

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Appendix 12.9 Rolling Stock Maintenance

Table 12.9-1 Weekly Schedule of Rolling Stock Maintenance Work

Date of shop-in	Kind of inspection	Rolling stock number	Steel repair work	paint ing	Wheel set	Brake parts	suspencim metal	Engine / Main motor	Torque converter / Auxiliary motor	Electric parts	Reverse gear / Reduce gear	Bogic assembly	Modification work
3/4	OH	EF65123	16 5	16 10								9 18	

Bogic insertion	Whole fixing	Performance test	ATS testing	Trial run	Delivery	Commercial line trial run	Remark
9 29	16 29	16 31	17 31	4/2	4/4		

Note
OH: Overhaul
16 / 15 — 16: o'clock, 15: Date

Table 12.9-2

Daily Schedule of Rolling Stock Maintenance Work

Assembling	Steel repair work	Painting	Apparatus work	Main motor	Electric parts	Bogie assembling	Bogie insertion
EF65456		16 6	16 10	16 10	16 10	14 14	9 21
Out-going	Whole fixing	Performance test	Trial run	Additional repair work		Delivery	Remark
EF65789	16 4	16 5	9 7			16 10	Commercial line trial run 11 13

Note : 16_ 6 ··· Date 16_··· o'clock

Table 12.9-3

Daily Directions of Rolling Stock Maintenance Work

In-coming locomotive	OH EF ------ Tyre exchange					
					Training	
					Buisiness trip	
Additional repair work			Remark			
Gear case exchange						
Assembling	Rolling stock number	Wheelset	main motor	Key adjust	Bogie assembling	Bogie insertion
	EF ------				5^{9}	7^{9}
	DD -----				11^{9}	15^{9}
Out-going	Rolling stock number	Performance test	Trial run	Fixing Additional repair work	Delivery	Remark
	EF ------		7^{9}		10^{16}	

Squad	Rolling stock number	Work contents		Person in charge
A	EF	Disassembling		Mr.A,Mr.B
B		Flaw detection	Bearing susoention	Mr.C
	EF	Brake parts repair	Axle box fixing	Mr.D
	EF ------	Main motor inspection		Mr.E
Wheelset	EF ------	Tyre exchange machining Axle machining		Mr.F
Steel work	EF -------	Door repair		Mr.G
	EF ------	--------		
	DD ------			
		Reclamation		Mr.H

Table 12.9-4 Table of Procurement and Stock for Parts(1997)

Parts code number	Parts name	Specification	Person in charge	Kind of rolling stock	Quantity equipped	Unit price	Quantity in '96				
							Brought over from'95	Procured	Brought over to '97	Actually	applied Number of cars applied
1 2 3 4 5	wheelset	-------	-------	------	------	-----	----	----	----	----	-----

Application rate	Quantity to be procured in '97	Planned money amount in '97	Planned to be brought over	Purpose of storage
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