PNCT 843-79-18

DEVELOPMENT PLAN at PNC for treatment technics of Pu-CONTAMINATED WASTES

(DRAFT)

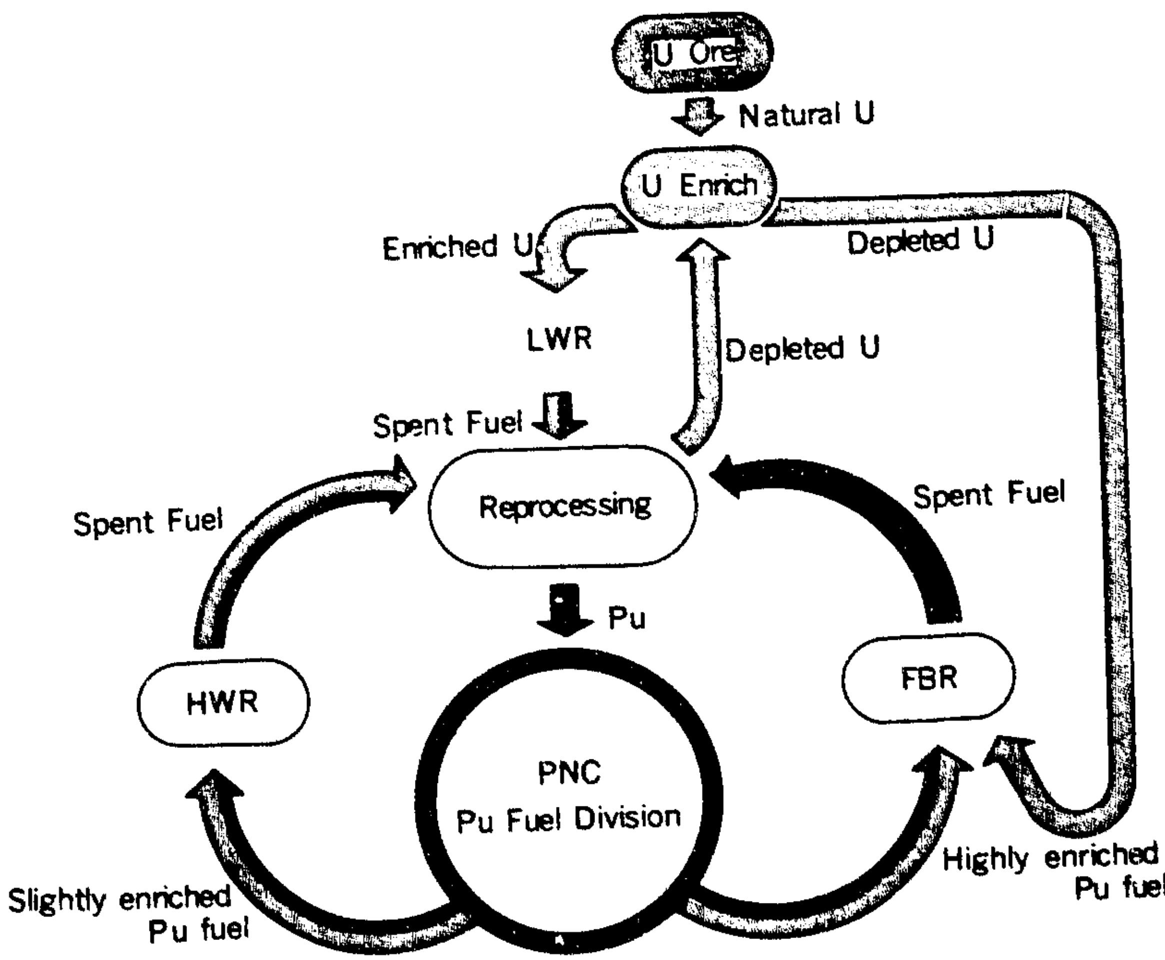
DEVELOPMENT OF PLUTONIUM FUELS

Since 1965, for the effective utilization of plutonium as nuclear fuel, PNC has been carrying out research on the basic characteristics of plutonium and the evaluation of plutonium fuel performance, including the design, test fabrication, irradiation and evaluation of fuels for the LWR, HWR and FBR.

At PNC's Tokai Works, since 1972, the plutonium fuel has been fabricated in amount of 92 fuel assemblies for the Deuterium Critical Assembly (DCA), 119 fuel assemblies for the core of the experimental fast reactor "JOYO" and 100 fuel assemblies for the advanced thermal reactor "FUGEN" in collaboration with advanced power reactor project groups. At present, the fuels for DCA are in fabrication to confirm the fuels design of demonstration ATR.

Regarding to the fuels for the prototype fast breeder reactor "MONJU", PNC is developing an automated fabrication line in advance of foreign countries.

The development of plutonium fuels has been performed with emphasis on the highest priority for safety. PNC has made and will further make the greatest effort to the realization of plutonium age.



DEVELOPMENT PLAN at PNC for treatment technics of Pu-CONTAMINATED WASTES

(DRAFT)

AUGUST, 1978

POWER REACTOR & NUCLEAR FUEL DEVELOPMENT CORPRATION

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Development Plan at PNC
for Treatment Technics
of Pu-contaminated Wastes

ABSTRACT

Pu-contaminated liquid waste is being discharged after having been decontaminated, while solid waste is being stored in storage facilities at PNC plutonium fuel facilities.

With the progress of plutonium fuel development, increase in quantity of Pu-contaminated waste to be stored makes it difficult to secure required numbers of storage facilities and to manage them, and also necessitates the volume reduction of stored waste to reduce the storage space. Then, the treatment for disposal is required, for which every possible decontamination, volume reduction and stabilization is desired so as to minimize risks associated with the disposal. Solidified waste is continued to store temporarily for the period until the guideline for the disposal is established and carried out.

The present technical development plan is aimed at volume reduction and immobilization of Pu-contaminated waste now being in question. This will cover the stage between the temporary storage of untreated solid waste and the final stage which contains transportation and disposal.

The main items for the development are as follows:

1) Combustible waste; incineration, acid digestion
2) Noncombustible waste; dismantling of HEPA filter, decontamination, pressing and solidification of large size waste material

Status of PNC Pu-contaminated waste management

Categories	Packages	Distribution (%)	Status	
PVC, neoprene rubber	PVC bags 20-1 carton box 200-1 drum	40	Acid digestion	20-1 digester incineration Engineering scale in 1978
HEPA filters (nipple connected wooden frame)	(used for glove box) PVC bags – 200-1 drum (used for room) PVC bags	26	Milling plywood frame → incineration Melting the filter components	Cold test Conceptual design
Paper, polyethylene	PVC bags 20-1 carton box 200-1 drum	19	Controlled-Air incineration (12 kg/h)	Modification, U-test Pu-test in 1978 Ash melting
Large equipments	PVC bags Steel container	9	Cut into small pieces Melting by induction heating or ESR	Dismantling of glove box Plasma cutting by remote control Cold test of melting Conceptual design
Metal, glass	PVC bags 200-1 drum	6	ibid.	ibid.

*) Since 1966, a total of 1,000 m^3 of solid waste was generated, almost of which has been stored in storages not to be treated.

1. Introduction

The Advisory Committee on Radioactive Waste Management of the Japan Atomic Energy Commission reported in June 1976 on "The Measures for Radioactive Waste Disposal and Management" (interim report). The interim report includes the countermeasure mainly for high level liquid waste and low level waste. While the countermeasure for alpha-bearing waste, decommissioned nuclear facilities, animal waste, spent organic solvent is reported to be considered as required demands. Quantity and generating source of alpha-bearing waste are at present limited and do not require to be treated but only to be stored in specifically provided storage facilities. However the report suggests that with the increase of generating quantity the treatment technology such as volume reduction by burning out combustible waste should be established, and at the same time it should be required to promote the research and development for the packaging of waste more suitable for long term storage, and also to study the method to distinguish alpha-bearing waste from other radioactive waste. Moreover, the report mentions on demolished nuclear facilities only that the systematic study on decommissioning is to be promoted.

Despite of present situation as mentioned above the importance on the countermeasure for Pu-contaminated waste has been increasing gradually as described hereunder and it is considered to take steps for it immediately.

However, seeing the present situation in Japan on the countermeasure for Pu-contaminated waste, most of them remain only stored without any treatment except liquid waste as pointed out in the interim report of the Advisory Committee, and the research and development has just started. Therefore, the disposal for isolation from the ecological zone is still being under study and its research and development has not been set about as yet.

Most of the development and handling for plutonium fuel in Japan is at present conducted at Tokai Works of Power Reactor and Nuclear Fuel Development Corporation. The development here aimes at utilization of plutonium as an energy source that does not exist in the natural world. Actual utilization is said to necessitate the solution of plutonium impact to the ecological zone. In other words, a proposition how to protect environmental safety against plutonium impact should be accomplished together with the development for the technology of plutonium fuel fabrication and its utilization.

The present technical development is aimed at the volume reduction and immobilization which are the urgent subject among various countermeasures for Pu-contaminated waste.

2. Necessity of Countermeasure for Pu-contaminated Waste

Radioactive waste generated from respective facilities of nuclear fuel cycles are classified to high level waste, low level waste, alpha-bearing waste and larger size waste. The high level waste with high radioactive level and the low level waste with very bulky volume have been considered immediately.

Despite of its hazard of longer life as well as usefulness of plutonium, the generating sources of alpha-bearing waste containing plutonium are limited from Plutonium Fuel Development Facility (PFDF) and Plutonium Fuel Fabrication Facility (PFFF) of PNC Plutonium Fuel Division and Pu-contaminated waste generated quantity amounted to only 180 m^3 per year in 1977. However the sources of Pu-contaminated waste generation and its quantity tend to increase gradually, when fuel production facility for the proto-type fast breeder "Monju" and for the demonstration advanced thermal reactor and other facilities are put into operation the quantity of waste to be generated is expected to exceed 300 m^3/y. Particularly, the recycle utilization of plutonium for reactor will greatly increase Pu-contaminated waste generation because radioactive waste from the plutonium-uranium mixed oxides fuel (MOX-fuel) fabrication facility will be added.

Fission products which share 99% in radioactivity level of high level waste will be reduced to 10^{-2} after 100 years and to 10^{-5} after 1,000 years. Therefore actinoid will exceed fission products of radioactivity after several hundred years and be characterized as alpha-bearing waste.

The above-mentioned consideration will necessitate Pu-contaminated waste management technology for isolation from ecological area over one million years as well as the management technology for high level waste and disposal of low level waste.

3. Emergency of Countermeasure against Pu-contaminated Waste

Most of Pu-contaminated waste are now put in containers such as drums etc. remained untreated in temporary storage. The temporary storage will be required to continue from now on before the Pu-contaminated Waste Treatment Facility (PWTF) will be newly developed and put into operation.

The temporary storage, however, comprises the following restriction:

1) Some of Pu-contaminated waste out of the temporary storage have already elapsed for 10 years, during which corrosion of containers have been progressing. Therefore an immediate countermeasure is required.
2) Transportation of untreated waste, prefers that the storage place should be located in the vicinity of the waste generating source. However, the installation of larger storage facilities now being under planning will make it considerably difficult to secure grounds for the construction of the 2nd and the 3rd storage at PNC Tokai-site.

As mentioned above, it is hardly possible to continue the temporary storage for untreated waste. Consequently the immediate construction for PWTF now being planned should be required to facilitate the volume reduction and immobilization as well as the storage space reduction and the increase of storage stability.

Solid waste which will be treated at the PWTF in considerably higher degree of volume reduction and stability could be stored in the larger storage facilities mentioned above temporarily till 1990 by when the final disposal of waste is said to be established.

4. Basic Principle on Pu-contaminated Waste Management

The continuation of temporary storage of untreated Pu-contaminated waste comprises a number of problems which are not only demerit to require considerably larger storage area but also safety against plutonium contamination due to fire, etc.

The treatment and disposal of Pu-contaminated waste is, therefore, indispensable, where the following considerations should be paid:

1) Even for Pu-contaminated waste the management should be liable to the generation who will receive the benefit of the nuclear fission energy.
2) However, there is at present no technology of solidification that ensures to exist in stable state over one million years long despite of environmental changes.
3) Accordingly, the disposal of Pu-contaminated waste should be carried out in the strata or similar instead of long period storage to isolate it from the ecological zone.
4) The above-mentioned consideration prefers the followings in connection with the decrease of dangerousness:

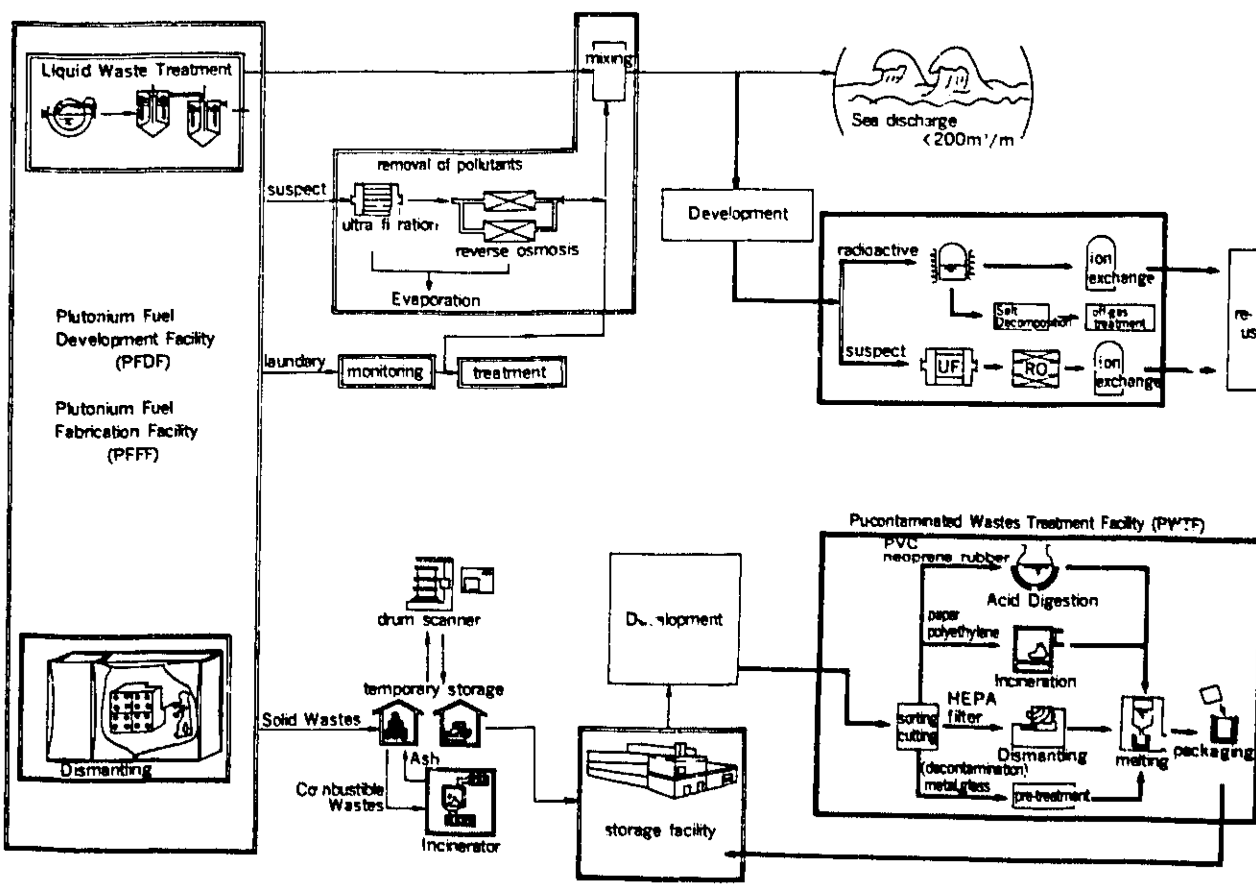


Fig.1 Management of Pu-Contaminated Wasts.

Table 1 R&D Program of Pu-Contaminated waste treatment technique.

	1977	1978	1979	1980	1981	1982	1983	1984
1 Combustible Waste								
1) Incinerator			Demonstration					
2) Acid Digestion	Laboratory Scale	Engineering Scale	C&R	Design	Construction		Demonstration	
3) Other Methods	research							
2 Non Combustible Waste								
1) HEPA Filter	development		C&R	Design	Construction		Demonstration	
2) Decontamination and Compaction	research		C&R	Design	Construction		Demonstration	
3) Melting	Laboratory Scale		Engineering Scale		C&R Design	Construction		Demonstration
3 Construction of Treatment Facility (PWTF)		Conceptual Design		Design License	Construction		Operation	
4 Construction of Storage Facility	Design	License	Construction			Storage		

a. To decontaminate plutonium from the waste so as to decrease plutonium quantity to be treated as low as practicable.

b. To perform the solidification for the disposed material as small and stable as practicable.

However, no matter what treatment method may be applied, it is preferred to adopt a simpler method since there will be by-produced waste, and also to perform the treatment in one same facility in case some of treatment method should be combined.

The Pu-contaminated waste management system taking into consideration for the easiness, economical evaluation etc. in addition to the above-mentioned are as mentioned below:

The most appropriate selection will be to perform the volume reduction and immobilization with suitable decontamination, packaging, temporary storage and study on the final disposal.

When the research and development reaches the demonstration stage for respective process, the economical point will come to the problem, where the economical evaluation should be required for the whole management system for Pu-contaminated waste including its final disposal.

The permissible upper limit of the Pu-contaminated waste management cost is to be determined by energy demands and electric power generating cost. The management cost will be classified into three categories, which are treatment cost, disposal cost and dangerousness cost. In this classification, respective costs have a tendency to be inverse-proportional one another. Therefore, in the selection of the whole process for Pu-contaminated waste management, the most adequate combination of the processes is to be considered in addition to the overall economical evaluation.

5. Process and Equipment Development

The countermeasure of Pu-contaminated waste should be proceeded keeping systematic connection with those of other radioactive waste. The main technical development plan to be carried out for the time being is as follows:

1) Treatment test for combustible waste

The test is carried out for the purpose of eliminating danger of fire as well as great volume reduction. Plutonium is concentrated into ash.

2) Treatment test for noncombustible waste

This test is conducted for the elimination of plutonium as contaminant as well as the volume reduction and immobilization of noncombustibles.

The research and development will be promoted maintaining the temporary storage as shown in Table 1 and Fig. 1. At the stage when the technology will be proven, a developmental facility for Pu-contaminated waste will be constructed to perform volume reduction and immobilization as well as to establish the treatment technology.

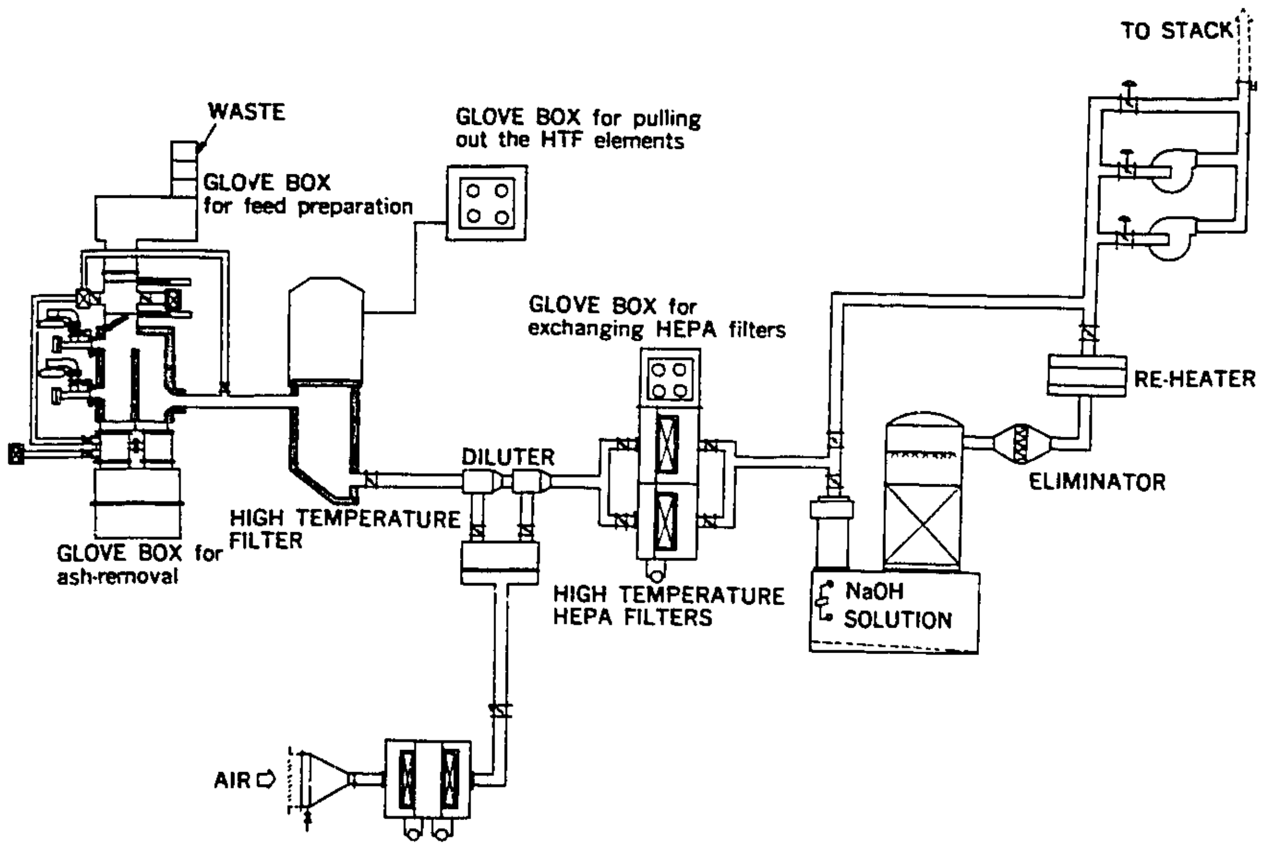


Fig.2 Iincineration System for Pu-Contaminated Wasts.

5.1 Treatment Test for Combustible Waste

1) Incineration

Pu-contaminated combustible waste such as paper, cloth, polyethylene etc. will be treated with the existing incinerator (capacity : 12 kg/h) installed at the Plutonium Fuel Development Facility (PFDF). The characteristics concerning incineration itself has been proved, while the operation and maintenance technic has not fully been proved as yet with the behavior of plutonium comprised in waste and the prevention against the expansion of plutonium contamination. Therefore, demonstration will be continued.

2) Acid digestion of chlorine-containing waste

On the other side, as regards chlorine-containing waste such as polyvinyl chloride (PVC) sheet, neoprene rubber gloves etc. which possess a great part of waste, it is necessary to select or develop a new suitable treatment technic for such waste, because the incineration of such waste gives a remarkably great damage to component parts of the incinerator due to corrosion of chlorine contained in the waste. In 1976, the feasibility study was made on the proper technics for the treatment of chlorine-containing waste and the following two methods were selected, namely, one is the acid digestion method by means of hot sulfuric acid and nitric acid and another is the fluidized-bed combuster made of special material. Among the above two, the acid digestion method, research and development of which had advanced in U.S.A. was remarked and the experiments for the method was started. The research and development of the acid digestion carried out in U.S.A. is not mainly aimed at chlorine-containing waste. Therefore, from 1976 to 1978, the preliminary experiments and conceptual design were carried out by PNC aiming at the treatment of chlorine waste, containing with the outcome that the reaction can be processed through two stages of carbonization with sulfuric acid and oxidation with nitric acid.

Engineering test:

Based on the above-mentioned study and experiments, an engineering test facility will be constructed in 1978 and the performance of the acid digestion process from the viewpoint of reliability, operation, safety, maintenance etc. will be conducted in 1979 through long period of its operation. The following is the outline of the engineering test facility of the acid digestion process.

The facility is composed mainly of – waste feeder, acid digestion equipment, oxidation absorbing equipment, acid fractional distillation equipment, waste gas treatment equipment, solution feeder, and others. Fig. 2 indicates the flow sheet.

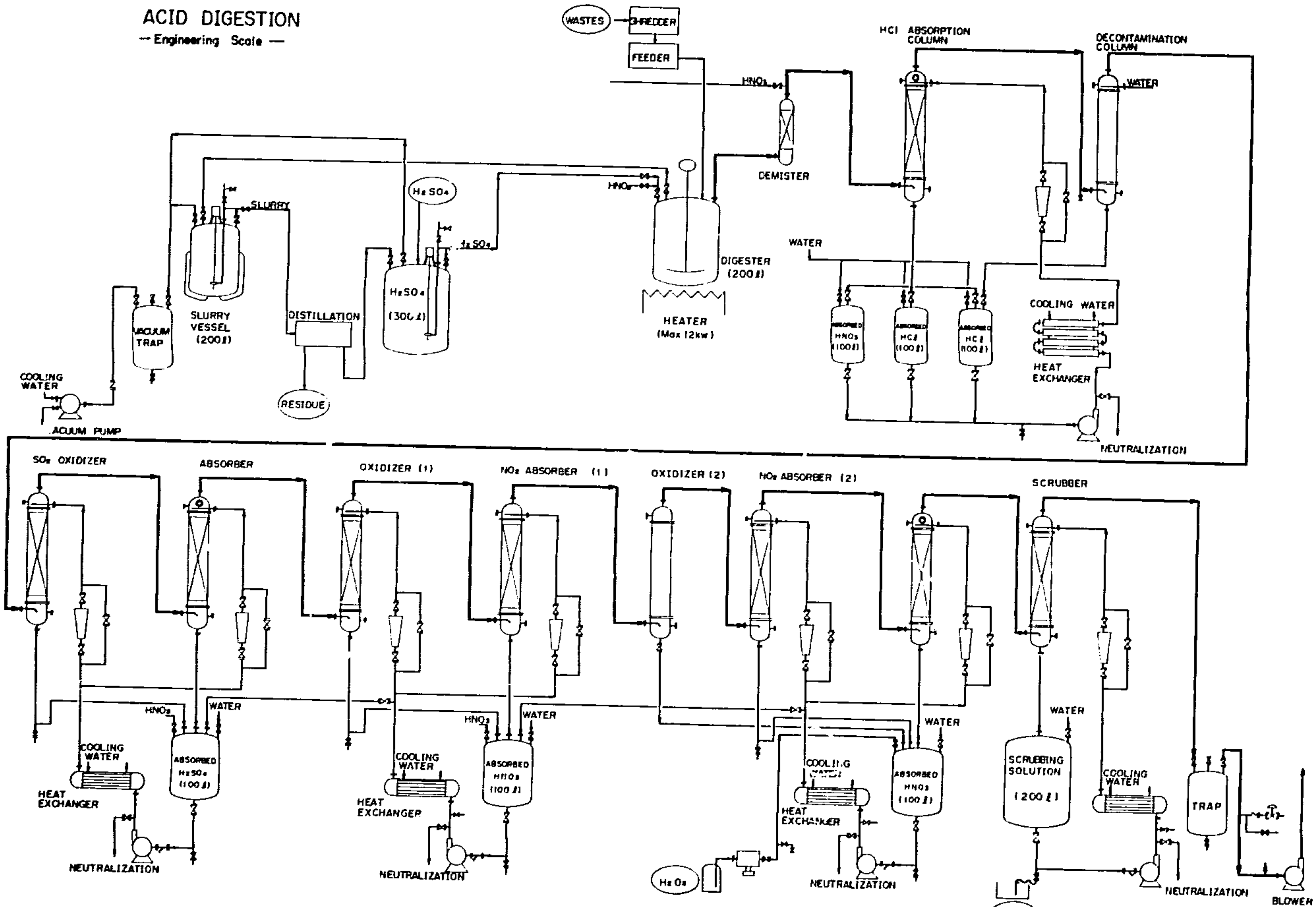


Fig. 3 Acid Digestion.

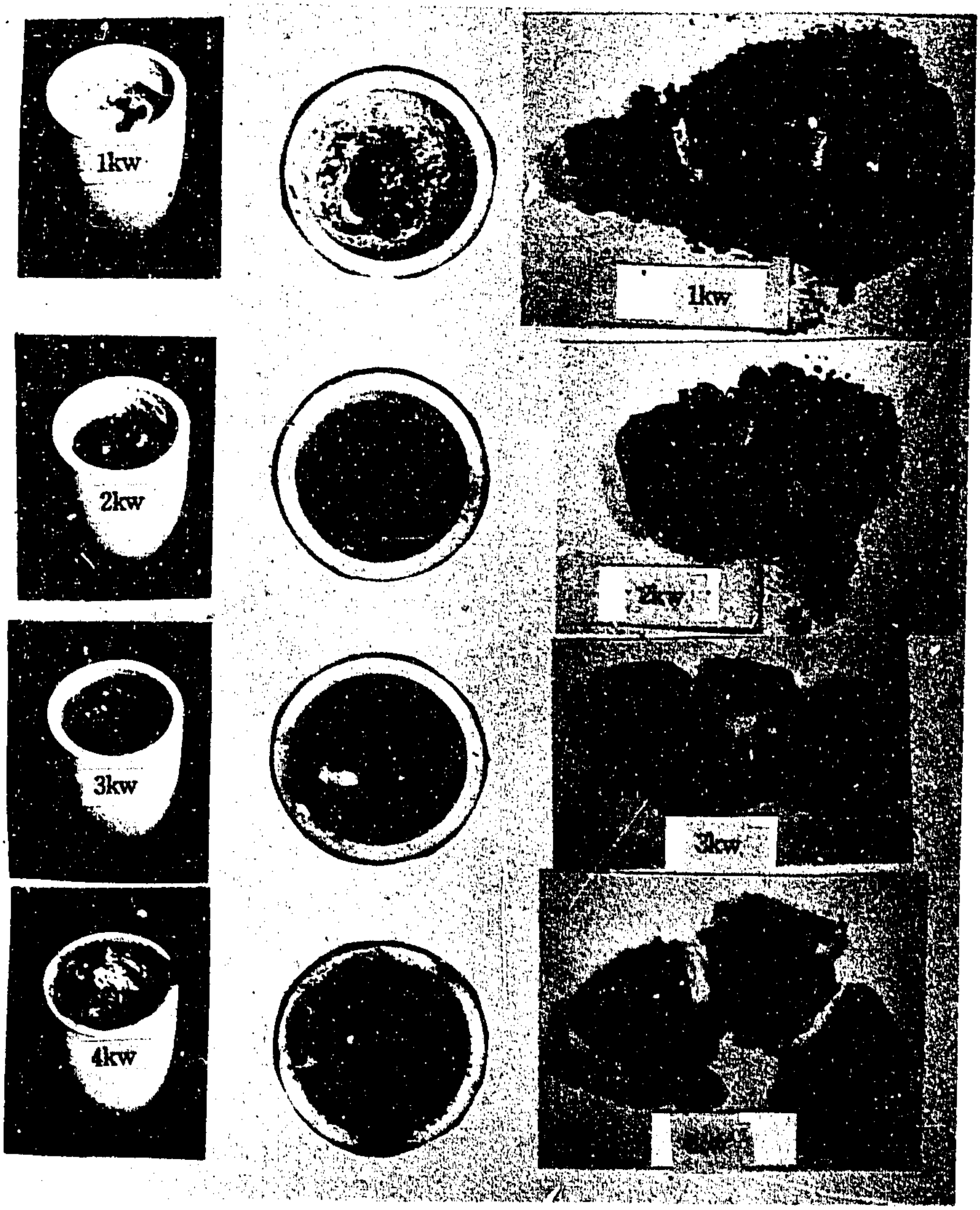


Fig.4 Solidified Ash by microwave powering method.

The process is outlined as follows:

Artificially made waste is fed to the acid digestion equipment through the feeder. Carbonized waste with hot high concentrated sulfuric acid in the acid digester receives a small quantity of high concentrated nitric acid additionally until oxidized completely. Gas generated through this process stage comprises three components, sulfuric acid, nitric acid, and hydrochloric acid, most of which are absorbed and separated in the acid fractional distillation equipment into sulfuric acid and nitric acid which will be reused in the acid digester. Non-condensive off gas such as CO_2, SOx, NOx etc. that could not be absorbed in the oxidation and absorption equipment will be emitted in the air after treated through the off gas cleaning equipment.

Demonstration facility:

The process demonstration test will be carried out for Pu-contaminated waste containing chlorine after having confirmed its process in the engineering test. The process demonstration test will be conducted in the PWTF. The detailed design will be proceeded aiming at the construction of the plant by early 1981. The hot test for the plant is planned to be made in early 1983.

3) Research on other incineration

In parallel with the operation of α-incinerator and the development of the acid digestion, the research on the molten salt incineration, fluidized-bed incineration, air-controlled incineration etc. are started and will be evaluated in 1979.

The evaluation, will judge whether the specific facility for paper, cloth, neoprene rubber etc. respectively should be provided or common facility could be used for all above wastes and its demonstration facility will be designed and manufactured.

4) Melting of incinerated ash and acid digested residue

Incinerated ash and/or acid digested residue can be melted to be glassy materials with the system being developed.

This technic uses a microwave power generator, wave cavity, off-gas cleaner, etc. and has following advantages.

Forming a glassy material without the addition of any solidifying reagent

Its heat generating capability from inside any material enables the ash to increase heating rate rapidly, and the itself as thermal insulator

Simplified mechanism and easy control

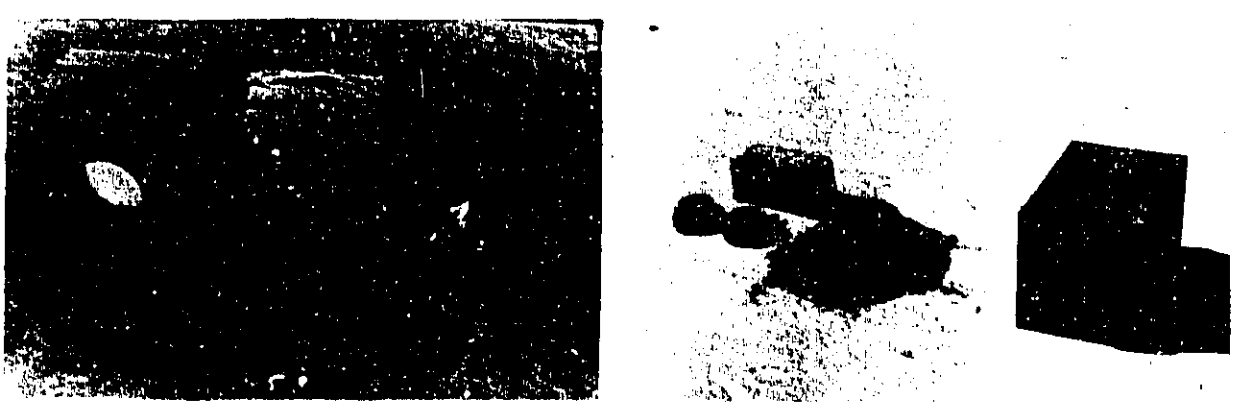
5.2 Treatment Test for Noncombustible Waste

At present, noncombustible Pu-contaminated waste is all put into containers such as a drum and stored temporarily without any treatment. The policy for the treatment and disposal is considered that plutonium should be eliminated as far as possible from waste, which is cut into small pieces, treated, volume-reduced, stabilized, and sealed into suitable containers and connected to disposal after some period storage.

Technics for decontamination and cutting into pieces will be proceeded referring to the research and development on "Method for decontamination and cut into pieces of the larger size noncombustible solid waste", that it being made at PNC Oarai Engineering Center.

1) HEPA filter

As the first stage of the technological development for the treatment of noncombustible waste, the treatment test for the HEPA filter was set about in 1976. Wooden frames of HEPA filter were cut, removed and burnt out, and the remaining filter components (glass fiber cloth and asbestos) were fed into the high frequency induction furnace and solidified after melting.



305 by 305 by 457mm 610 by 610 by 508 mm

Fig.5 Milled HEPA filter.

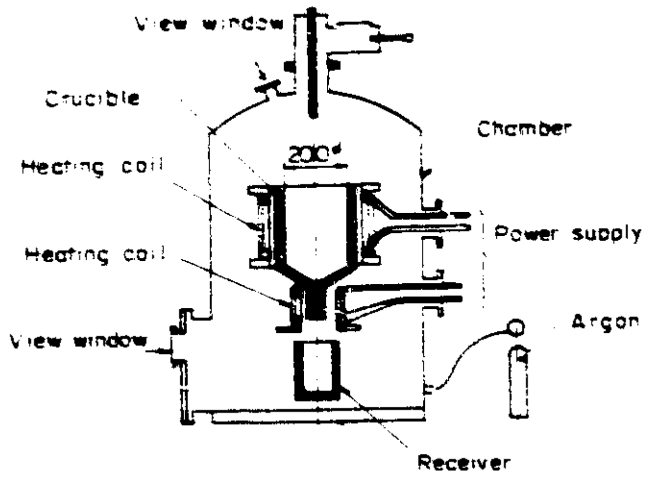


Fig.6 Experimental melter for HEPA filter components.

For cutting a kind of milling machine was manufactured for trial. Succeedingly the designing work will be proceeded for practical use of the milling machine.

The melting test revealed the homogeneous solidification to be achieved by heating above 1600°C.

The detailed design of the melting equipment will be carried out after the 2nd melting test and conceptual design are finished.

In 1979 the development work will be evaluated, and designing and manufacturing of the demonstration equipment will be set about from 1980.

2) Compaction of noncombustible waste

The melting solidification treatment is preferable also for noncombustible waste other than HEPA filter from the viewpoint of volume reduction and immobilization.

However, as it would take longer time before the establishment of its proven technics as compared with other ones, the compaction treatment is taken up as a temporary treatment for the research.

Namely, the compaction treatment will be performed after corresponding necessary decontamination and temporarily stored for a certain period before the melting technic is established.

3) Melting solidification of noncombustible waste

For the melting solidification treatment of noncombustible waste contaminated with plutonium, it is necessary to confirm mainly the possibility of the facility inspection and maintenance. As the first stage, the study and preliminary experiments were conducted by May 1978 on the melting solidification for the metallic waste conceptual design and experiments are conducted in 1978. The engineering test equipment will be manufactured in 1979 mainly consisting of high frequency induction furnace or ESR furnace (capacity : 100 kg/batch/h).

The engineering test equipment consists of a pre-treatment equipment, a melting furnace, an ingot pouring equipment, a carrier and a off-gas cleaning equipment. The pre-treatment equipment serves for the elimination of combustible waste and shredding of waste. Waste is melted in a crucible. The melting furnace consisting mainly of the high frequency induction heating furnace or ESR furnace serves for melting waste in the crucible. The ingot pouring equipment serves for pouring melt from the crucible into a melt receiver. The carrier consists of a carriage with lift for moving the crucible, an equipment for moving-in and -out the crucible to and from the pre-treatment equipment and rails. The off-gas cleaning equipment serves for the treatment of off-gas from the pre-treatment equipment and the melting equipment. This test is a cold test but it will be continued for longer period simulating the practical operation of the facility and also aiming at the full research on the inspection and maintenance.

Demonstration-test

Based on the results of the above-mentioned tests, the noncombustible waste treatment facility will be installed in the PWTF. From 1984, the hot test will start for Pu-contaminated waste.

5.3 Storage Facility for Pu-Contaminated Waste

Since last 10 years when the development for plutonium fuel was set about, Pu-contaminated waste was generated in PNC and has temporarily been stored not to be treated. The temporary storage must be continued except combustible waste until the Pu-contaminated waste treatment technics are established.

A larger size of Pu-contaminated waste storage facility will be installed from 1978 to 1980 as a substitution until the establishment of the Pu-contaminated waste treatment technics. When the treatment is started, the facility will be utilized for the temporary storage prior to the treatment, and for storage of solidified waste.

The outline of the storage facility is as follows: (Fig. 7) The facility is an automatic high-rack storage where 6000 drums of Pu-contaminated waste can be stored safely. To prevent the leakage of Pu outside the drums, an automatic remote carrying system will be adopted without only relying on the skillfulness of operators.

A seismic design of the facility is conducted on its structural part and machinery. Moreover, the design adopted economical and safe construction attaching importance to airtightness. Even if plutonium should leak out outside drums, a ventilation system will protect against decontamination scattering.

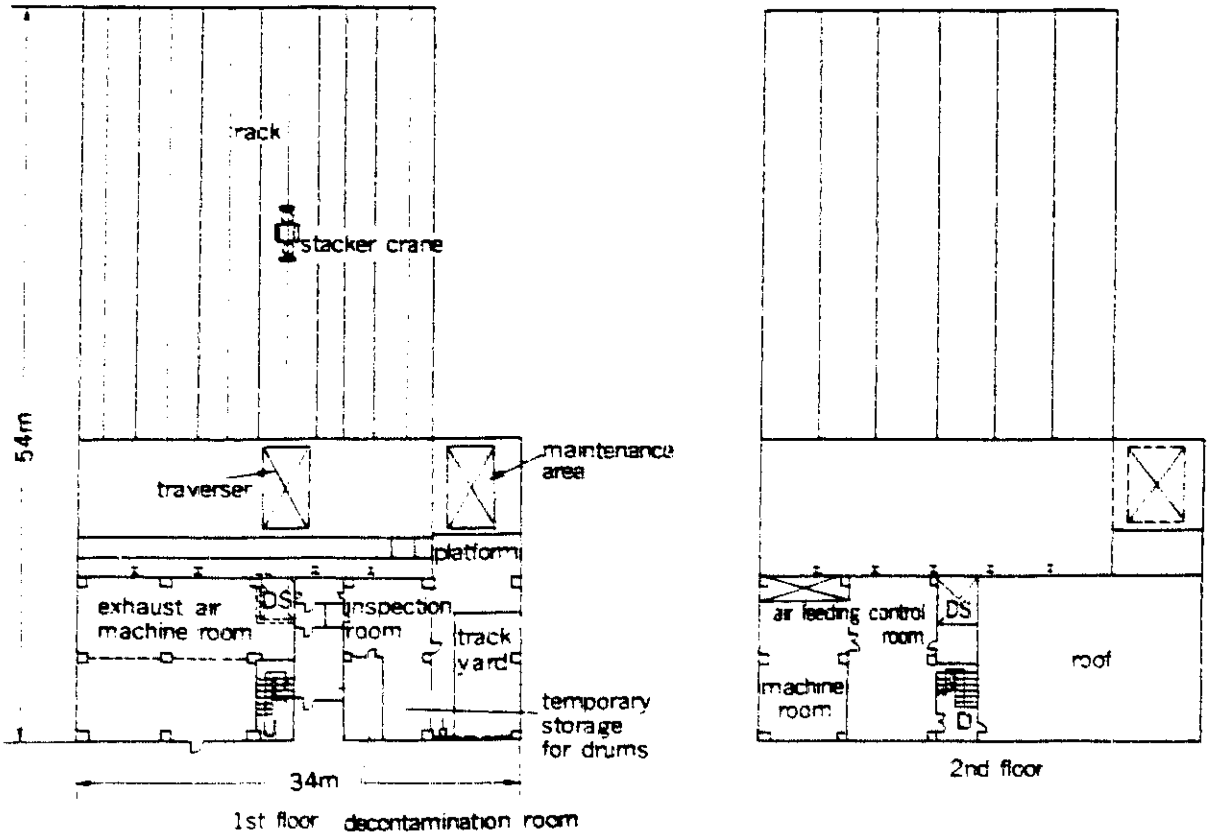


Fig.7 A ground plane of the Storage Facility.

5.4 PWTF for the Development of Pu-contaminated Waste Treatment Technics

The development for waste treatment technics will be proceeded while the Pu-contaminated waste will be temporarily stored. To demonstrate the developed technics, the facility PWTF will have to be installed (total floor area of approx. 6000 m^2) as indicated in Fig. 8. The schedule is planned to perform the conceptional design in 1978 and 1979, the detailed design as well as the licensing in 1979 and construct the facility in 1980 to 1982.

The developed technics which will reach the actual demonstrational stage, will be installed in the PWTF one after another depending on their progress in the development, and will be demonstrated while it will treat Pu-contaminated waste.

The facility will be constructed at south-west side of the Pu-contaminated waste storage as indicated in Fig. 9 and Fig. 10.

5.5 Other Process/Equipment Development

1) Decommissioning

The establishment of the decommissioning technics has become required to utilize plutonium handling facilities effectively and to dismantle the facility when it comes to the life.

It is very useful for decommissioning to experience decontamination, repair and reconstruction not only at the plutonium facilities but also usual nuclear facilities. Therefore, actual data collection and information exchange will be proceeded positively. At the same time, the removal and disposal of gloveboxes, tanks and larger equipment etc. will be proceeded to accumulate the know-how on the decommissioning. The working objects will be expanded one by one from unit equipment to a overall facility and the step by step establishment of the decommissioning technics will be intended. On the other hand, as regards the plutonium facilities to be constructed from now on, easiness of operation, treatment methods for waste generated etc. will be considered at the stage of design assuming the possible decommissioning of the facilities in the future.
The following explain concrete procedures:

Up to now, larger size of waste such as gloveboxes and tanks have been sealed with PVC sheet without any volume-reduction and put in containers placed at waste storages. However, recent increase of large wastes necessitates volume-reduction at the origin to reduce the stored volume.

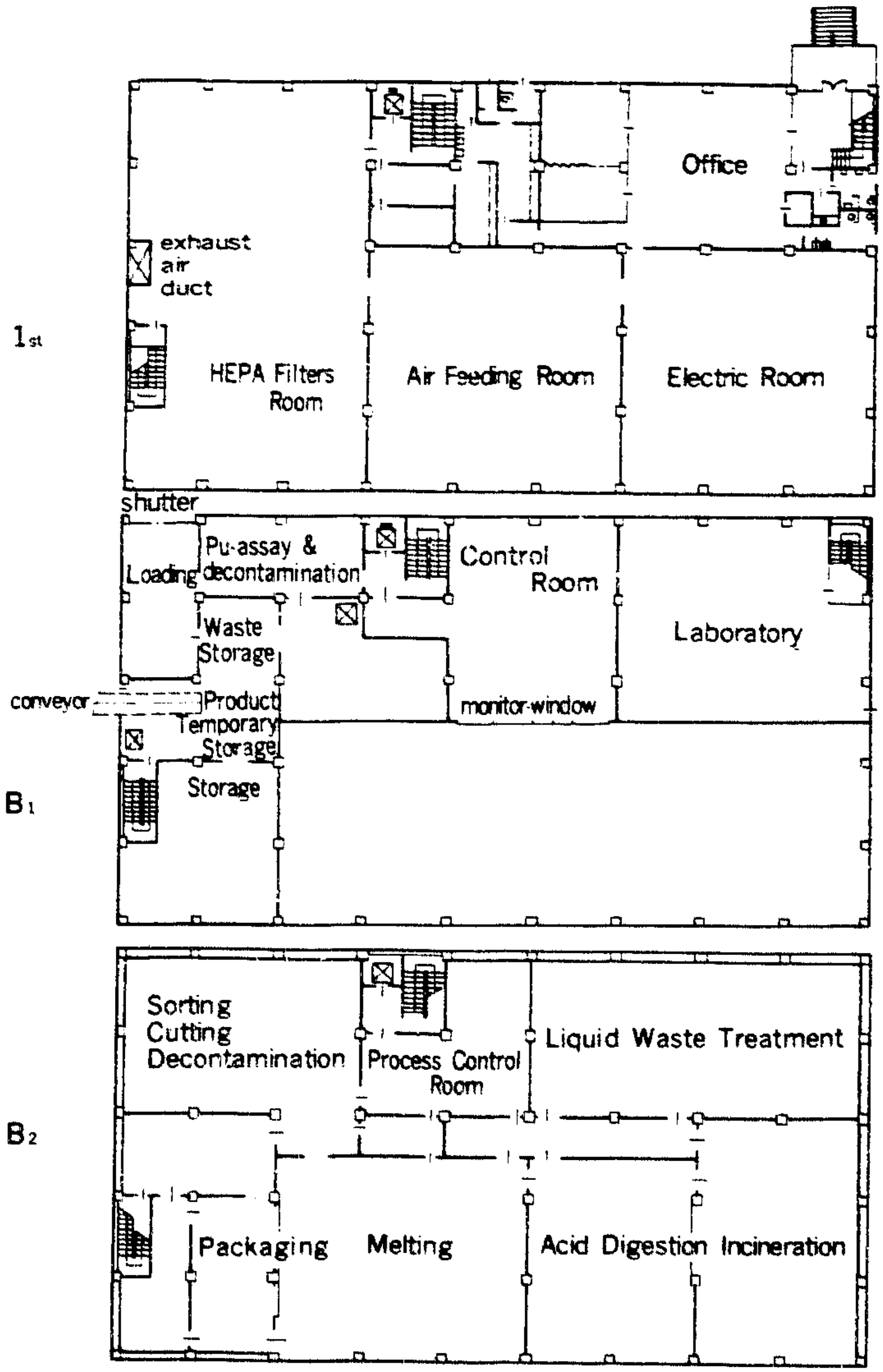


Fig.8 A ground plane of PWTF.

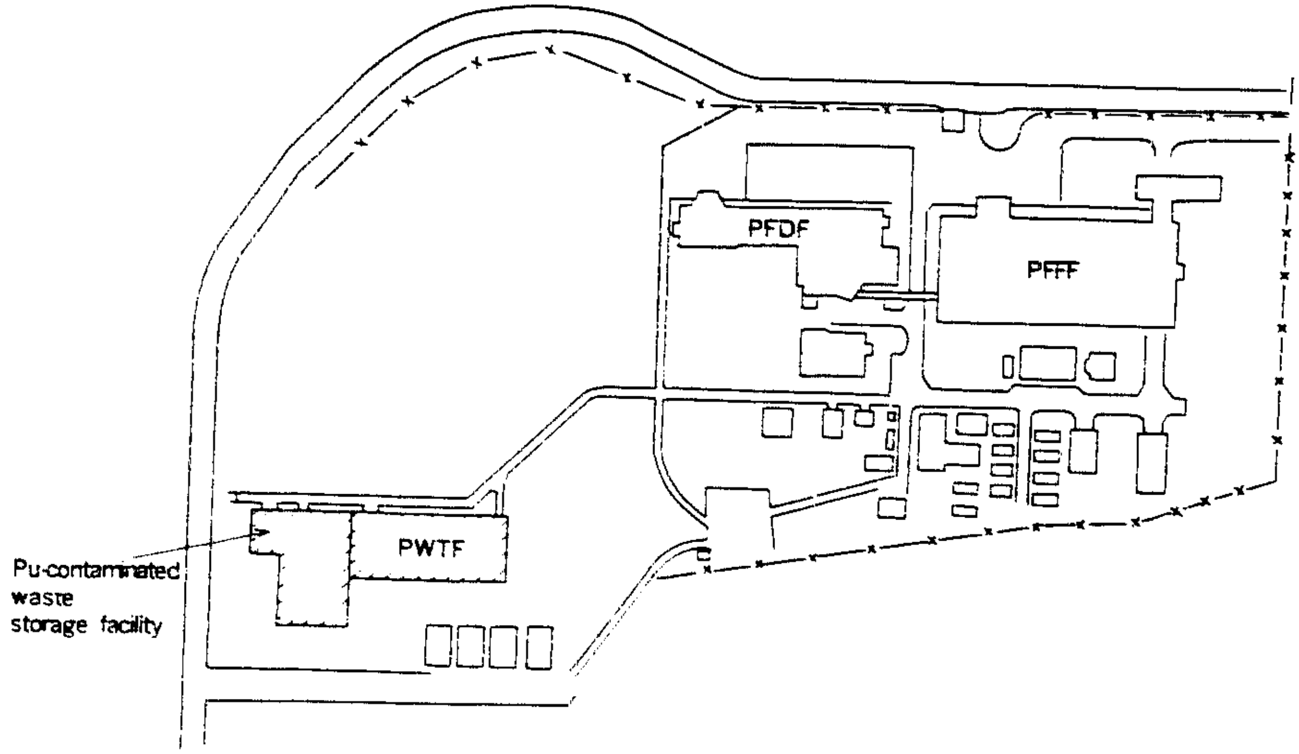


Fig.9 Layout of plutonium facilities.

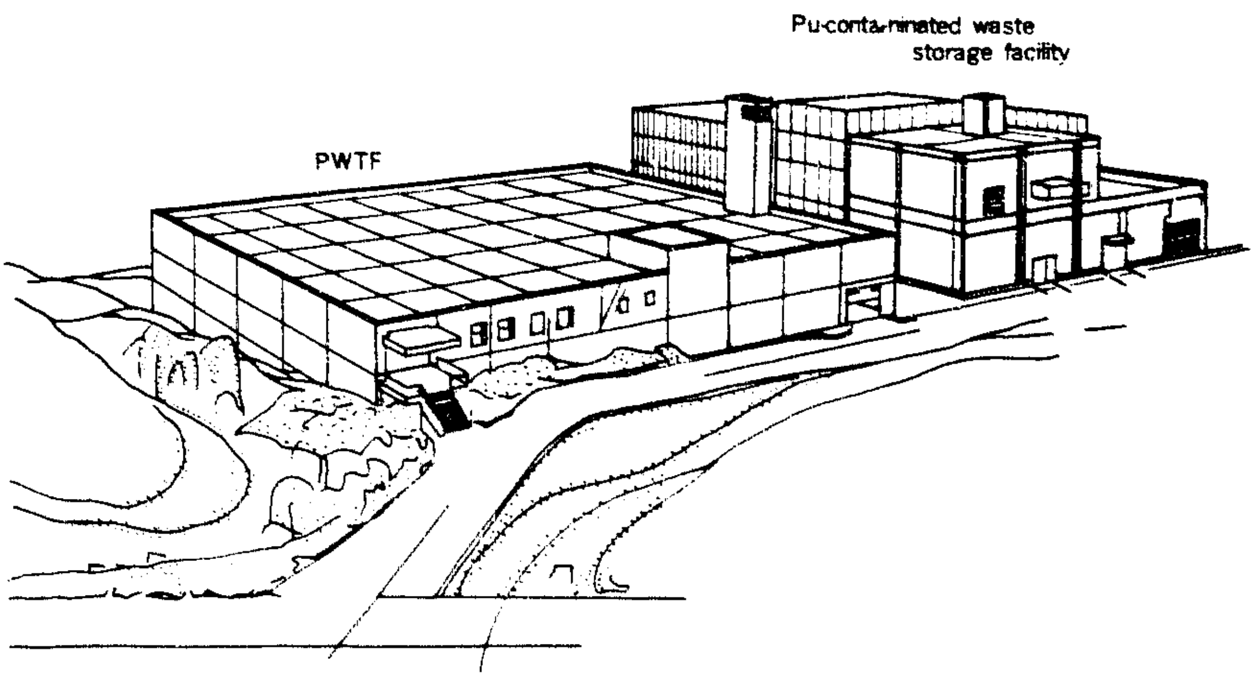


Fig.10 PWTF and Storage Facility.

At the first case of real volume reduction, a polyethylene made tank (3 m^3) used for storing Pu-contaminated liquid waste and a steel tank (6 m^3) were cut by an electric saw or plasma torch in 1977.

The mock-up test for dismantling non-contaminated glovebox, was conducted in early 1977. Based on this result, plutonium contaminated gloveboxes and larger size equipment were cut into pieces and removed in 1977 and 1978. The dismantling objects will be expanded after 1978 based on the experience on scrapping and removal of gloveboxes, tanks and larger equipment as well as jigs and facilities for scrapping and removal which had been developed in parallel. That is, a series of gloveboxes in the process will be scrapped and removed, so that the rooms for the gloveboxes will be utilized for new purposes.

2) Development of containing system for larger size waste

Larger size waste, even though minimized in size as far as possible, sometimes could not be contained physically in drum. Containers which are used repeatedly for transportation to the PWTF and preliminary storage of large size waste will be developed by 1978.

The development has been conducted since 1976. The trial manufacture following the design study was made in 1977 and the dropping test, air-tightness test etc. were carried out with the containers manufactured for trial. The results will be evaluated for the final design in 1978.

3) Determination of plutonium quantity in Pu-contaminated waste

The test measurement with a drum scanner will be continued, which has been performed by PNC Plutonium Fuel Division since 1973 for the purpose of the determination of plutonium quantity in drum waste. The test measurement is also set about with a carton scanner which was installed in 1976. As soon as the incinerator is put into operation, the plutonium quantity in the incinerated ash will be determined, the result of which will be compared with those gained from the measurement from the above-mentioned drum scanner and carton scanner in order to grasp the limit and accuracy of the detection at the nondestructive measurement of plutonium quantity in Pu-contaminated waste.

The plutonium quantity determination method for Pu-contaminated waste which could not be put in drums such as HEPA filters, gloveboxes, tanks etc. will be developed. The plutonium quantity determination method

4) Removal and recovery of plutonium from waste

The less plutonium content in waste, the less risk the waste management will have. Therefore, plutonium will have to be removed so that the content should be reduced as far as possible. Liquid waste generated in the PFDF and PFFF of Plutonium Fuel Division is now reaching monthly 200 m^3 at maximum. Appropriate countermeasure must be taken for it also taking into consideration of increase of liquid waste expected from now on. As it is also preferred to minimize the effect to the environment as low as possible, the systematization for reutilization of these liquid waste or its closed system will be proceeded. The feasibility study was made in 1975 and the systematization for reutilization of these liquid waste and its closed system development is planned as shown in Fig. 11. A larger quantity of ammonium nitrate contained in Pu-contaminated liquid waste generated from the process will be safely decomposed to non-toxic gas.

On the other hand, pollutants in the suspect liquid waste will be rejected for the purpose of re-utilization of water. Particularly in the former process, no example for technical development has been existing so far in and out of Japan. Therefore the development will have to be proceeded. (Pu-contaminated liquid waste treatment test) In the latter case, a development has so far been promoted in the field of the industrial water reutilization, to which reference is made. However, pollutants contained in liquid waste at pressent will be discharged to the sea below the regulated level with the necessary measure. (pollutants elimination test)

Organic liquid waste the quantity of which is rather less, will be stored in bottles, while the development of the treatment technic will be proceeded.

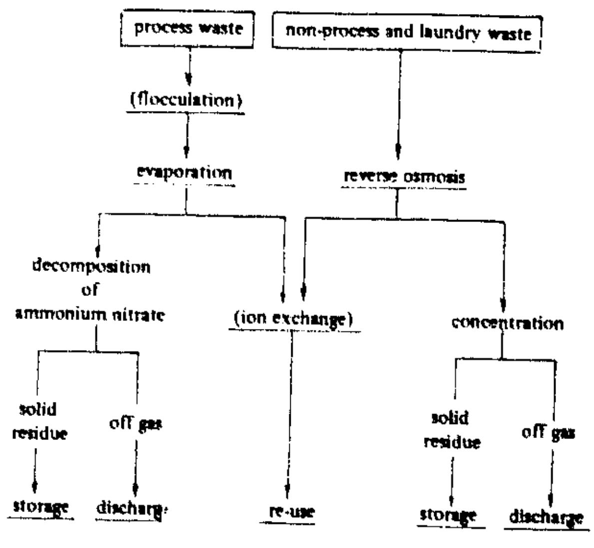


Fig.11 A flowsheet for a closed cycle system of liquid wastes.

Plutonium removal and recovery proof-test:

The technics of plutonium recovery will be demonstrated on ash, sludge, liquid waste, etc. which contain a little plutonium, while it will reduce the quantity of by-produced waste.

Pu-contaminated liquid waste treatment test:

The technics will be demonstrated so that ammonium nitrate contained in Pu-contaminated liquid waste in the quantity of 20 – 30 wt.% can be safely decomposed to recover plutonium.

In 1975, a test equipment was manufactured for thermal decomposition of ammonium nitrate by means of fluidized-bed system. Experiments with the equipments carried out in 1976, proved the possibility to decompose safely ammonium nitrate.

Succeedingly in 1977, a off-gas treatment test equipment was manufactured to make gas harmless that is generated from thermal decomposition of ammonium nitrate consisting mainly of NOx. In 1978 the off-gas treatment test with the equipment will be executed.

On the other hand, experiments for electrodialysis of ammonium nitrate to N_2 gas are conducted in 1978 and 1979 in order to compare with the thermal decomposition method.

Then, in order to demonstrate the Pu-contaminated liquid waste treatment technic, the design for Pu-contaminated liquid waste treatment facility will be proceeded in 1980.

Radioactivity:

To decontaminate the Pu-contaminated liquid, the floccuation method has been used with $FeCl_3$, PAC, etc.

This method had some disadvantages to necessitate a long period of sludge settling time and difficult solid-liquid separation.

For the purpose to solve these disadvantages, magnetic separator has been successfully applied to the floccuation method. (Fig. 12)

The magnetic separated sludge is treated with the microwave-powered oven. (Fig. 13)

Pollutants elimination test: (Fig. 14, 15)

An equipment will be installed experimentally for the elimination of pollution restricted material like BOD, COD etc. contained in discharged water in the sea. In 1976, an elimination equipment consisting mainly of the reverse osmosis membrane.

Succeedingly in 1978, the post-treatment equipment will be installed to treat concentrated liquid waste generated in the equipment, thus the pollution restricted material elimination test will be completed.

Analysis liquid waste treatment equipment:

With developing plutonium fuel, analysis liquid waste is being generated from a chemical analysis process. So far the analysis liquid waste has been separated into solid and liquid after neutralization in the glovebox, and succeedingly dried, calcined and stored. However, a series of working contains a number of processes, which not only require manpower but has more radioactivity exposure rate. One process solidification of analysis liquid waste will make it possible to simplify the process and to reduce the radioactivity exposure.

The treatment technology will be demonstrated in the treatment of actually gained liquid by means of an equipment installed in the glovebox enability to dry and solidify directly analysis liquid waste.

5) Research on transport

Transport of Pu-contaminated solid waste is classified into the one from storage facility in the source to the disposal place and the other to the strata storage as its substitute. Pu-contaminated waste, which is rather lower in the radioactivity, is expected to belong to the category of A type transported material stipulated in "Safety standard for transport of radioactive material (Japan Atomic Energy Commission, dated January 21st, 1975)", while it might belong to the category of B-type depending on the decontamination degree prior to the solidification treatment. Therefore research will be proceeded in consideration of the both types. It will be determined at the pre-stage of the manufacture of actual transport containers which type of waste in question will belong to A-type or B-type. Required data will be accumulated in the similar model with the actual one to establish the designing standard, safe transport standard and the container performance test method.

6) Research on disposal

The research on the disposal of high level waste into the strata, on the disposal for low level waste in the sea and on the disposal for low level waste on land will be proceeded referring to the progress of corresponding technological researches and developments.

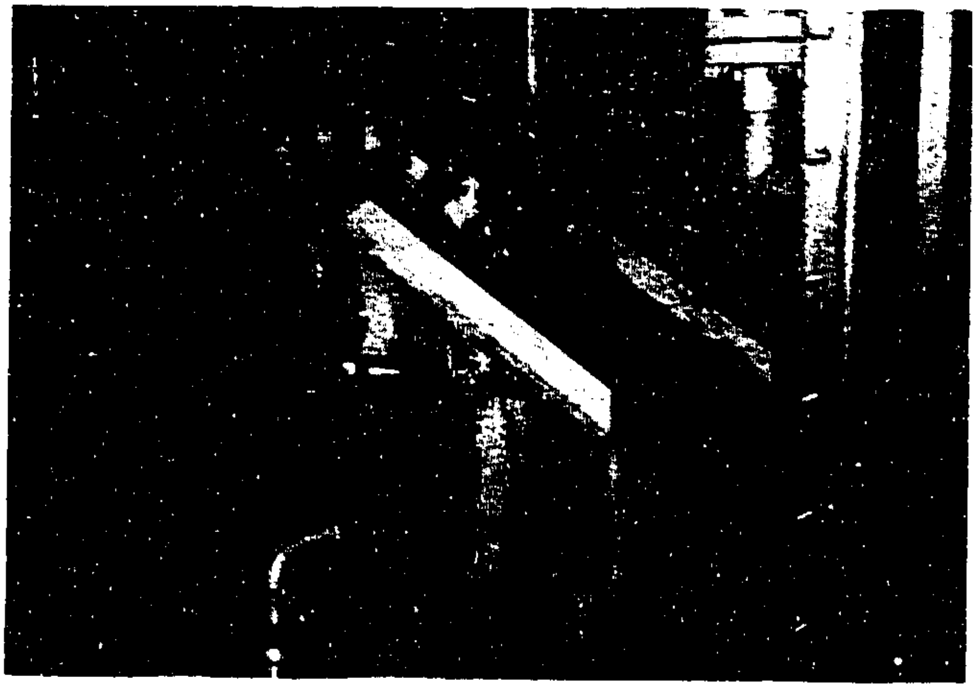


Fig.12 Magnetic Separater.

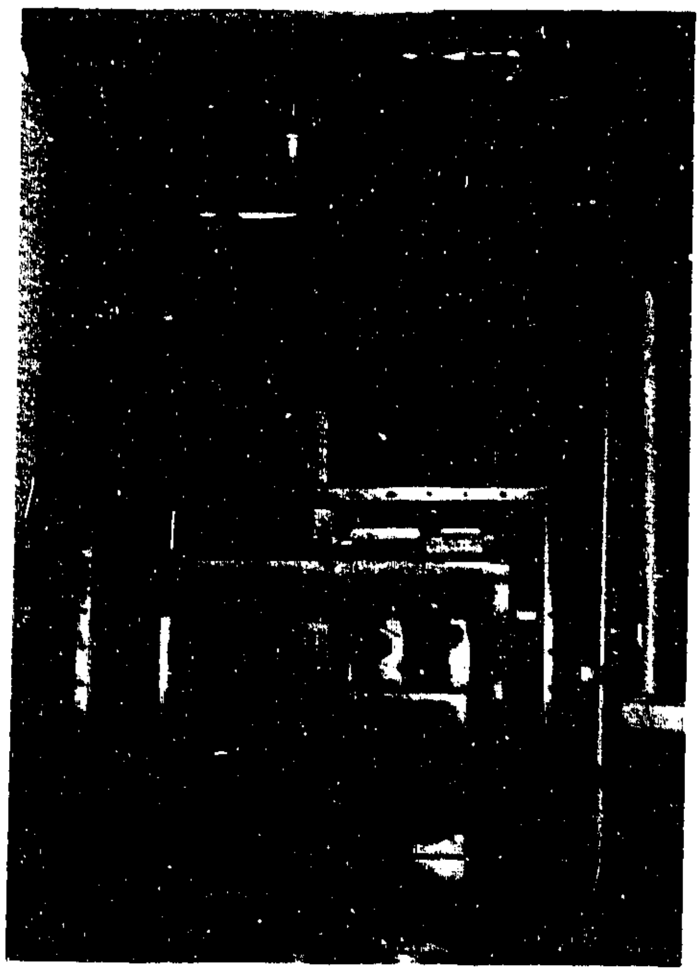


Fig.13 Microwave-powered oven for sludge.

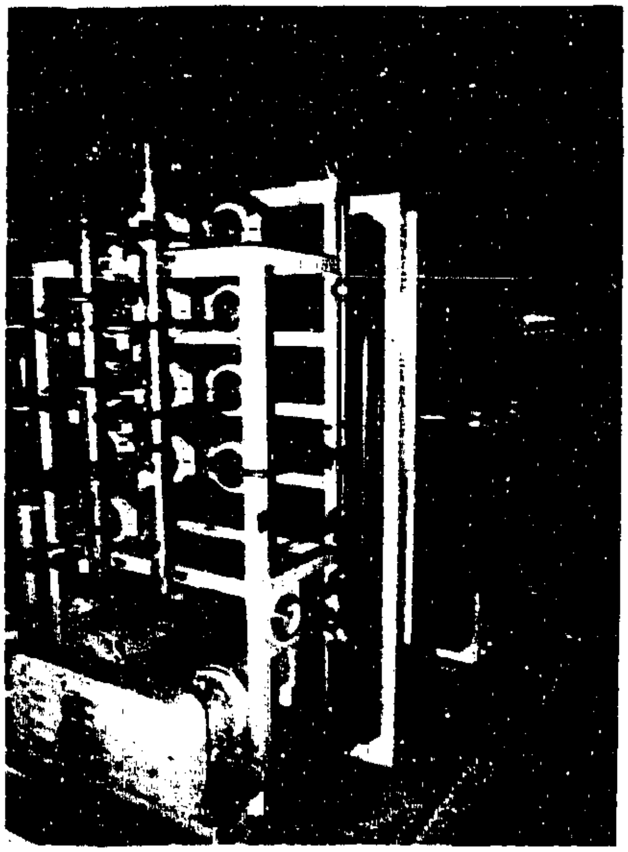


Fig.14 Reverse Osmosis.

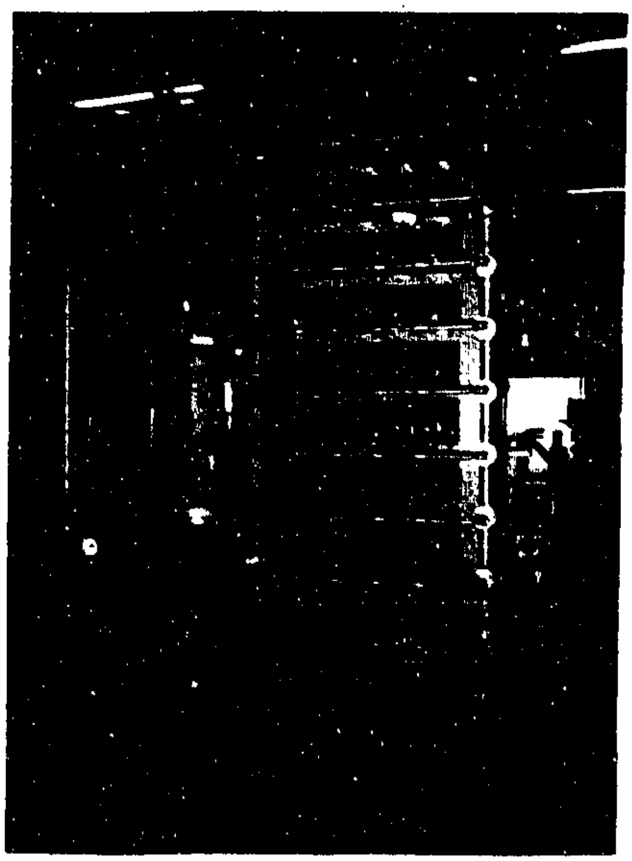


Fig.15 Ultra filtration.