Electron Beam Treatment Plant for Textile Dyeing Wastewater

June 08, 2005

EB-Tech Co.
The City of Daegu
Korea Dyeing Tech. Center
Daegu Dyeing Industrial Complex
International Atomic Energy Agency
Korea Atomic Energy Research Institute
Ministry of Science and Technology of Korea

International Symposium on the Utilization of Accelerators of IAEA, Dubrovnik, Croatia

1. Backgrounds

2. Pilot Plant Operation

3. Industrial Plant Construction

4. Future Prospects

Why Textile Dyeing Wastewater ?

(1000m^3/day)

	Number of Companies (%)	Amount of waste-water generated (%)	Amount of waste-water discharged (%)
Textile co.	1,423 (5.6)	473 (5.4)	457 (19.2)
Papermill	268 (1.1)	711 (8.1)	364 (15.3)
Light ind.	511 (2.0)	390 (4.5)	243 (10.2)
Processing ind.	3,376 (13.3)	439 (5.0)	200 (8.4)
Metal Fabrication	437 (1.7)	5,346 (61.1)	169 (7.1)
Others	19,284 (76.2)	1,382 (15.8)	942 (39.7)
Total	25,299 (100)	8,741 (100)	2,375 (100)

The amount of waste water generated and discharged in Korea, as of 1995

Importance of Textile Dyeing Wastewater

(1000m^3/day)

	1995	1996	1997	1998
Total	2,375	2,511	2,618	2,614
Textile co.	457	452	552	551
Ratio(%)	19.2	18.0	21.1	21.0

Annual Discharge of Dyeing Wastewater from Textile co.


FREE MAP
Seoul
EB TECH CO. (Central Research Institute of Samsung Heavy Ind.)
Daegu Dyeing Industrial Complex
강원도
울릉도
인천
서울
경기도
충청북도
충청남도
대전
경상북도
대구
울산
전라북도
경상남도
부산
광주
전라남도
제주도
: Existing Dyeing Complex
: Under construction
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Daegu Dyeing Industrial Complex

- over 120 companies of dip dyeing, printing and yarn dyeing
- high consumption of water(90,000t/day),steam(515t/day),electricity(53,100kW)

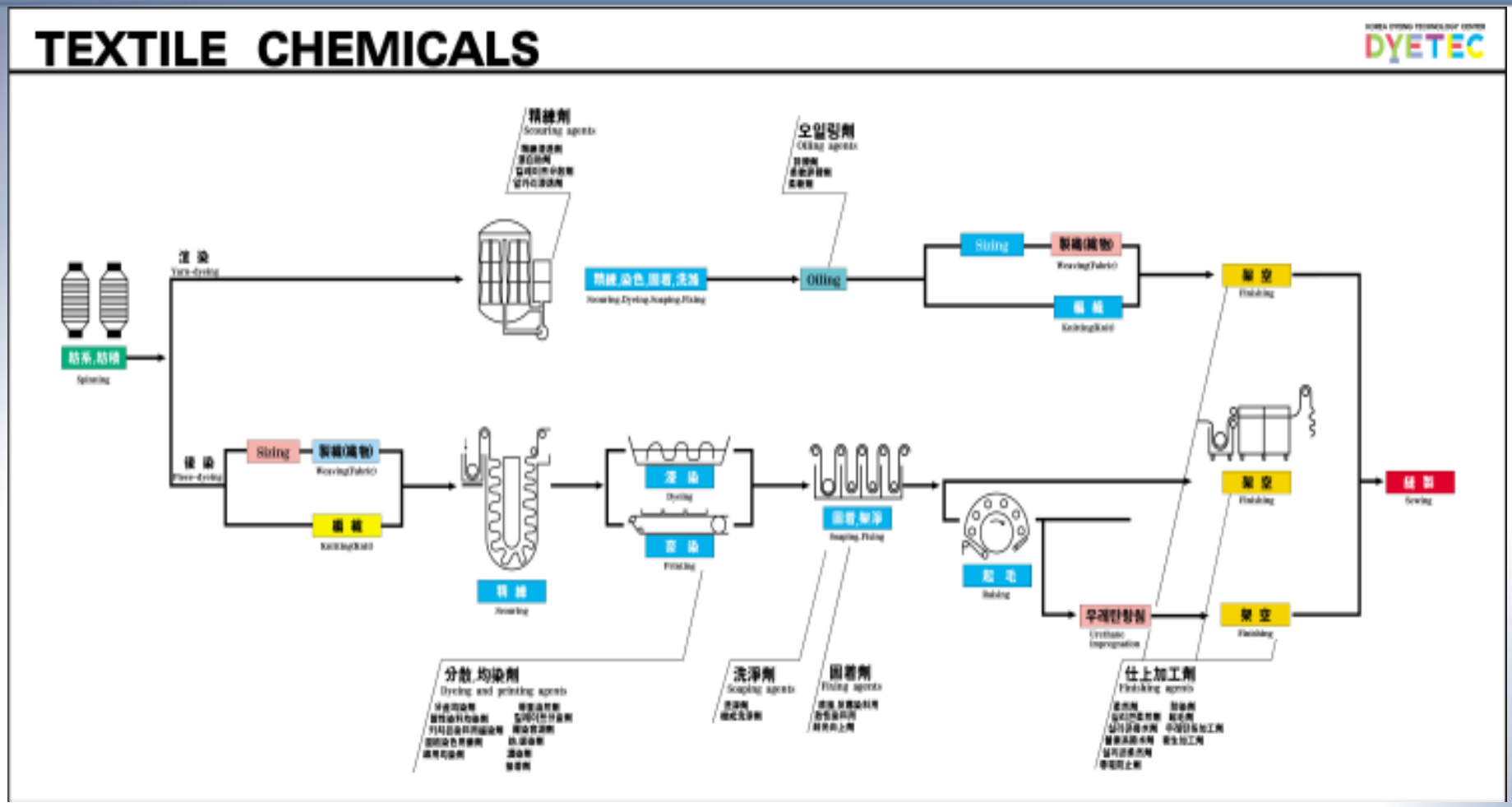
Existing Wastewater Treatment Facilities

- up to 80,000m^3/day
- coagulation with Chemical and Biological treatment
- close to limit ability

Parameter	pH	BOD_5, mg/l	COD_{Mn}, mg/l	Suspended solids, mg/l	Color, units
Raw wastewater	12	2,000	900	100	1,000
after Chemical Treatment	6.8-7.5	1,700	450	50	500
after 1st Bio-treatment	7.0-8.0	1,300	250	50	400
after 2nd Bio-treatment	7.0-8.0	30	60	50	250

Items	total	Dip dyeing	Printing	Yarn dyeing
Factories	112	95	6	11
Total	9,982	9,050	404	528
Man	6,941	6,238	324	379
Woman	3,041	2,812	80	149

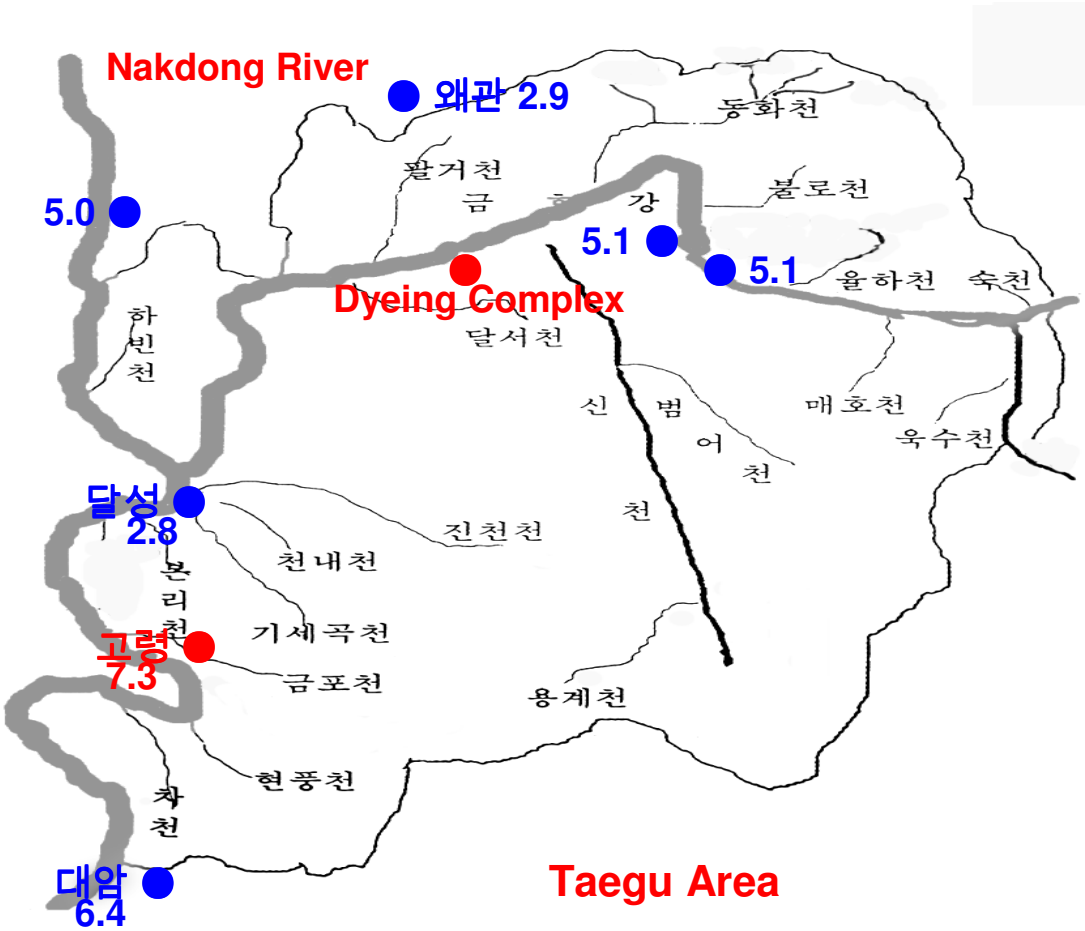
Factories and Employee in Daegu Dyeing Industrial Complex



Process of Textile Dyeing

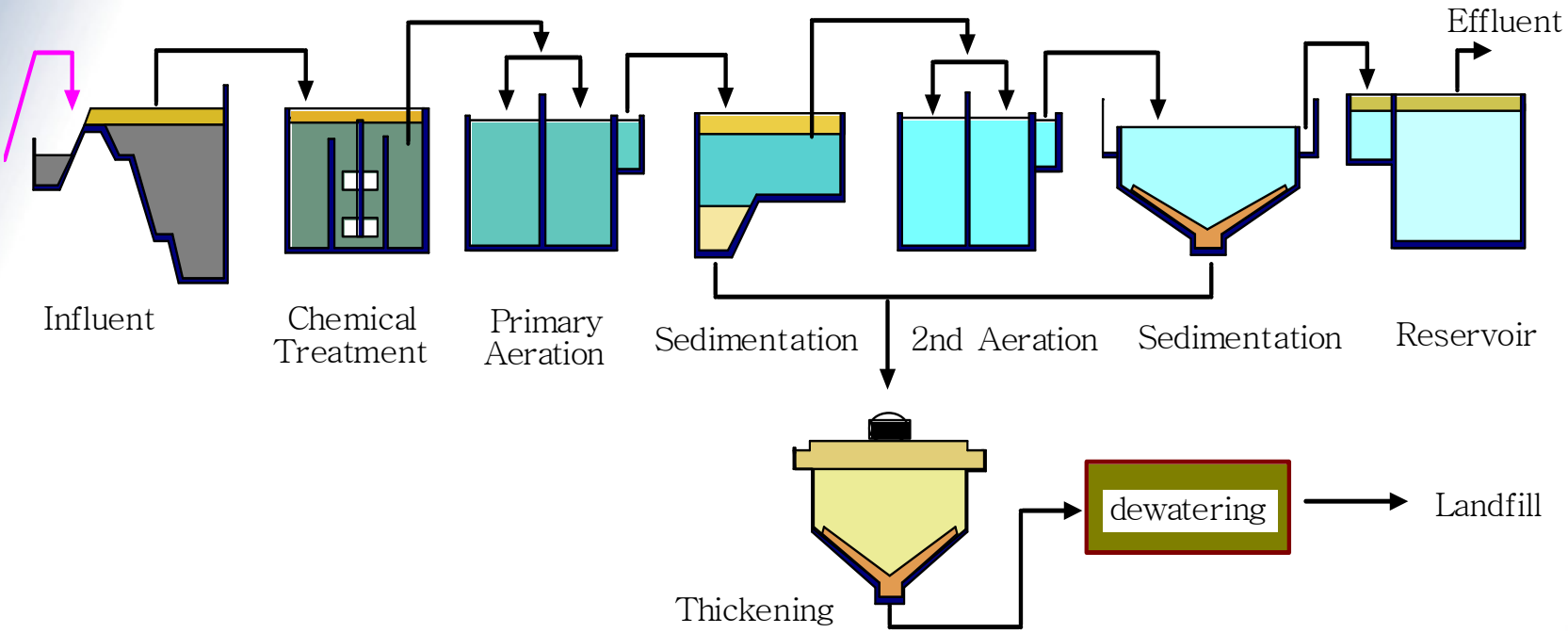
Items	BOD_5	COD_{MN}	Remarks
Polyester fabrics	1,796	829	
Cotton & Cellulose fabrics	680	1,236	
Nylon	448	471	
Printing	422	804	
Yarn Dying	256	303	

Characteristic of Textile Dyeing Wastewater in DYCEN



Degree of Contamination (in BOD) around Daegu Area, 1998

Wastewater Treatment Facility in Daegu Dyeing Industrial Complex

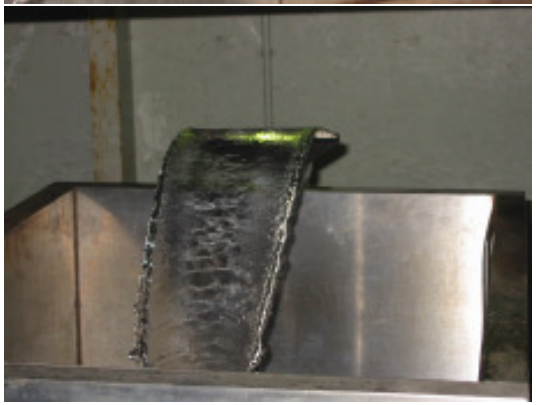


Process Flow of Existing Wastewater Treatment Facility

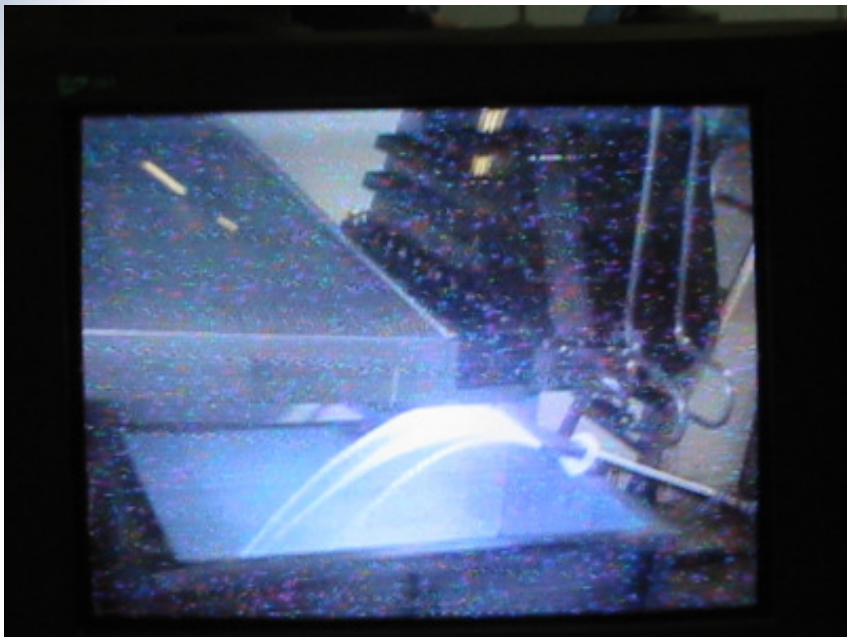
Researches on Wastewater Treatment

- 1994~1995 : Lab. scale feasibility Test with e-beam and Gamma ray
- 95.12~99.5 : Researches on Dyeing Wastewater Treatment with e-beam (Dyeing Technology Center/EB-TECH Co.)
- 96.2 ~97.2 : Treatment of Dyes and Dyeing Wastewater
- 97.2~98.10 : Construction of e-beam Pilot Plant (1000m^3/day)
- 98.10~present : Continuous operation of treatment facility
- 1998.9.16 : KT (Korea New Technology) Award
- 2000.7.19 : IR52 Industrial Research Award
- 2001~2006 : IAEA TC Project (Demo Plant Construction)
- 2001~2003 : Preparation for Plant Construction
- 2004 : Start up of Demo Plant Construction

Batch Type Experiment

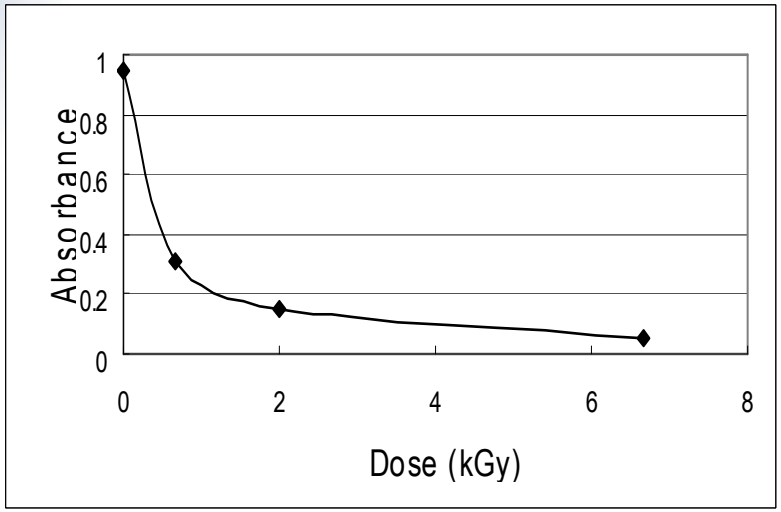


Nozzle-type Injector and Bench-scale System

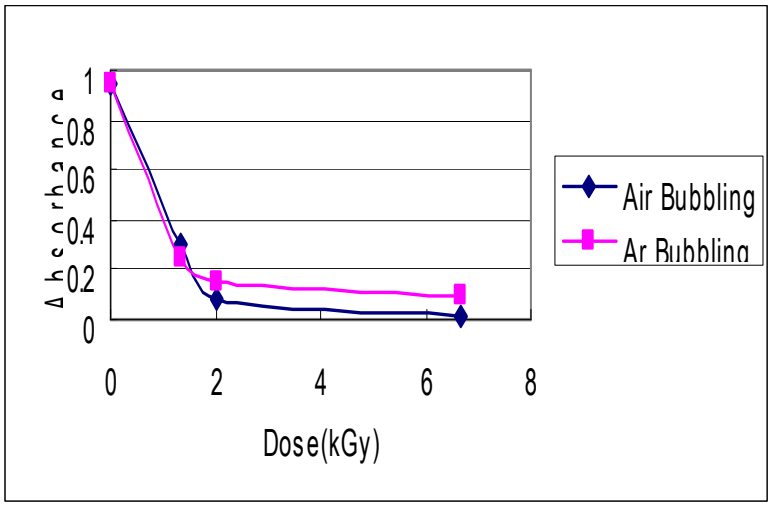


Wastewater under irradiation through Nozzle-type Injector

⊙ Absorbance of Reactive dye

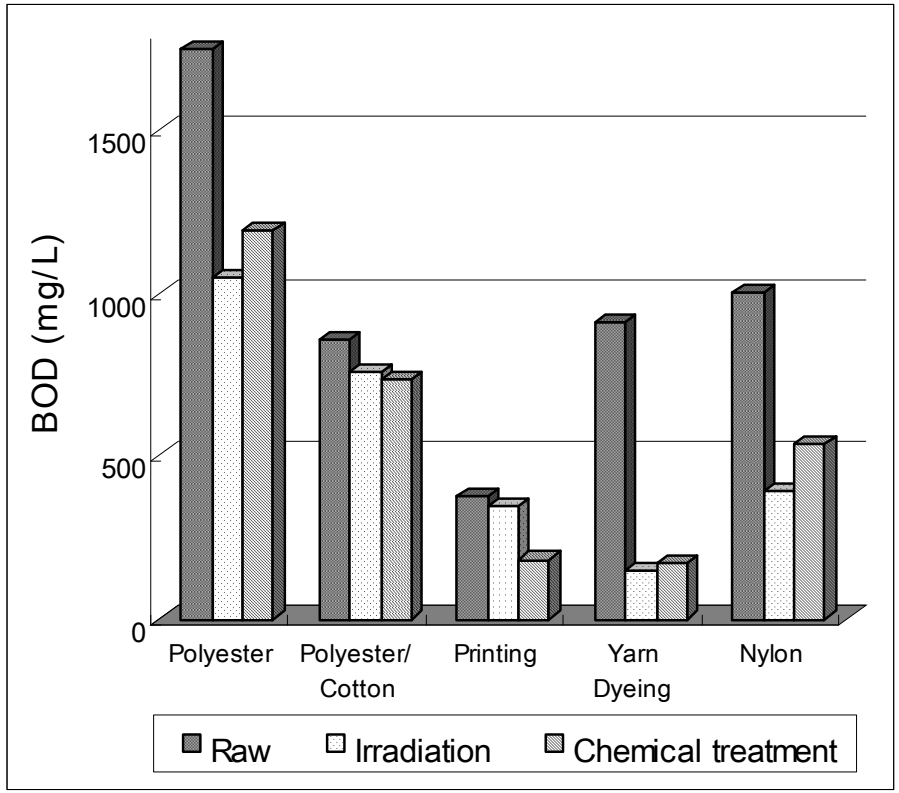


⊙ Absorbance of Reduction & Oxidation



Absorbance of Reactive Dyestuff (Reactive Red 21)

⊙ Removal Efficiency



BOD_5 reduction for wastewaters from different industry

1. Backgrounds

2. Pilot Plant Operation

3. Industrial Plant Construction

4. Future Prospects

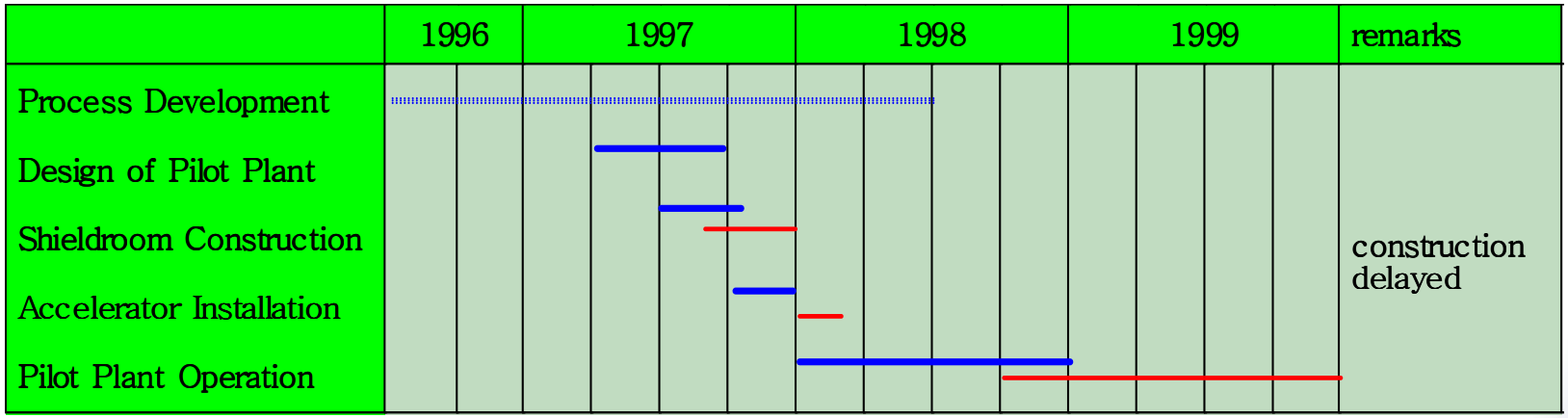
Pilot Plant for Treating Wastewater from Dyeing Process

- to find the effective methods of treating wastewater
- to improve the decoloration and destruction of organic impurities

Characteristics of Pilot Plant

- Maximum flow rate of 1000m^3/day with 1MeV, 40kW accelerator
- Combined with Biological and Chemical Treatment

Construction and Operation



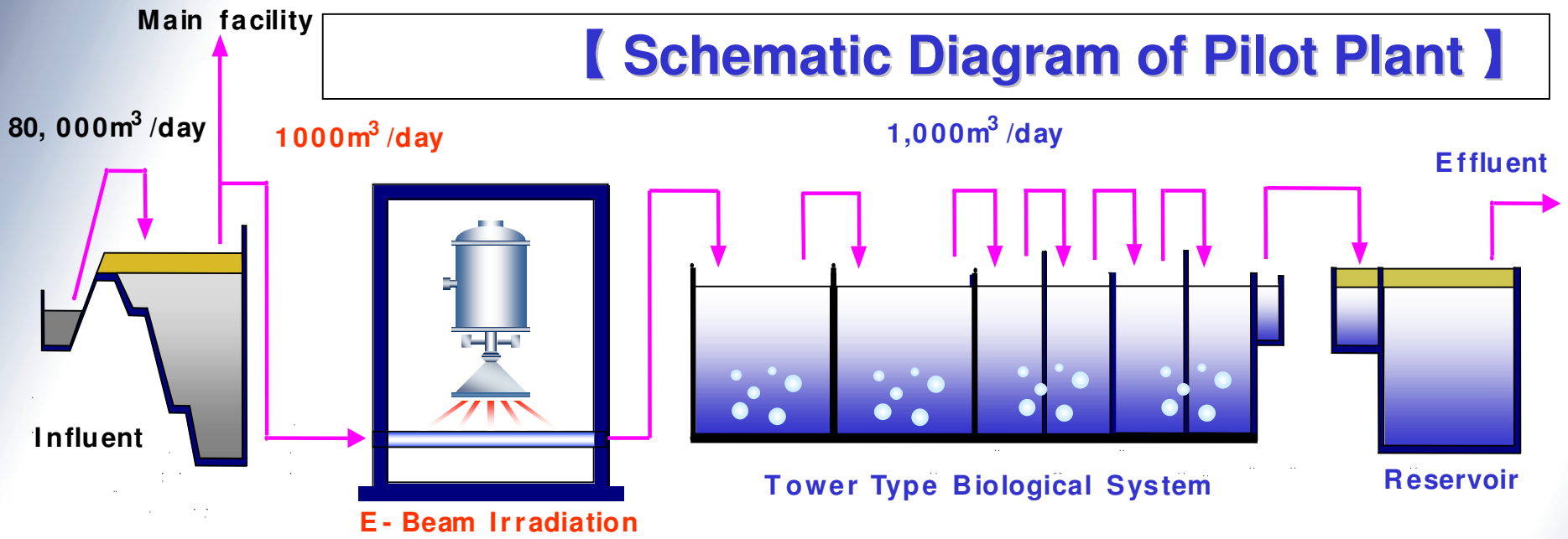
Location of Pilot Plant

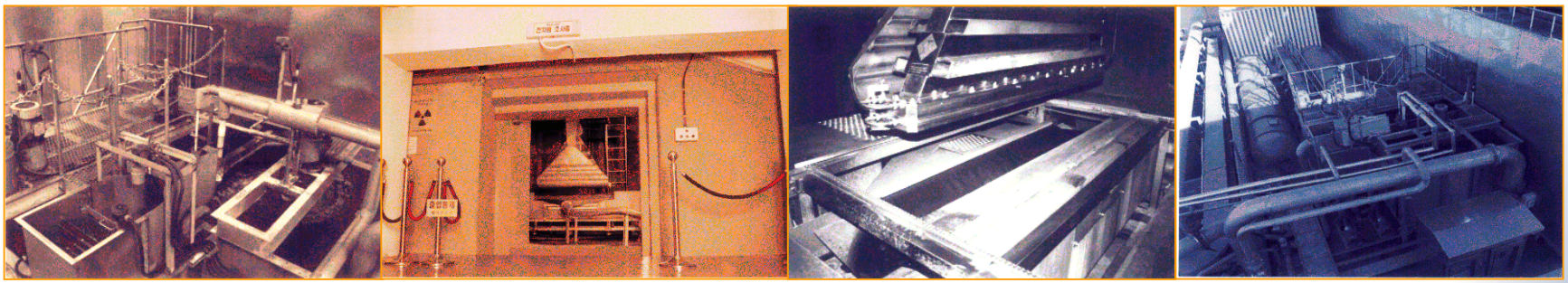
Wastewater Treatment Facility in Daegu Dyeing Industrial Complex

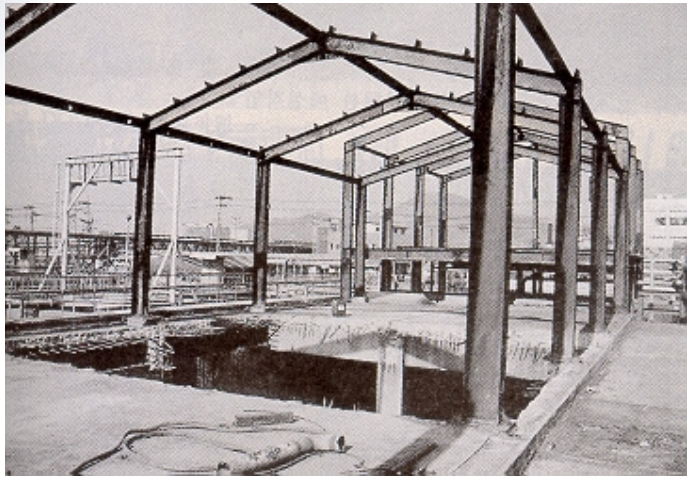
DYETEC 한국염색기술연구소

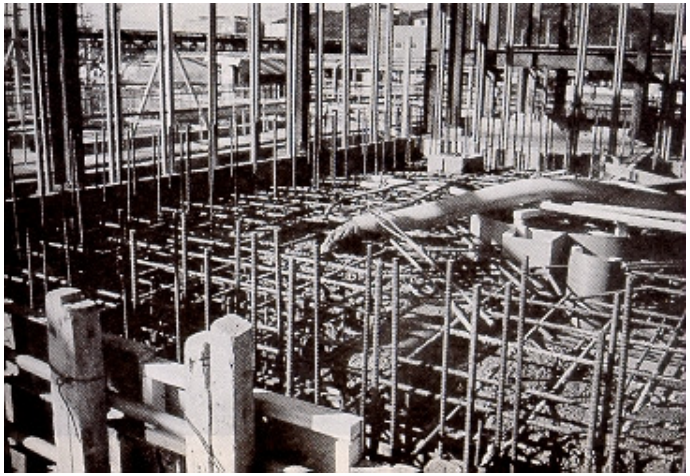
대구 염색산업단지 관리공단 Daegu Dyeing Industrial Center

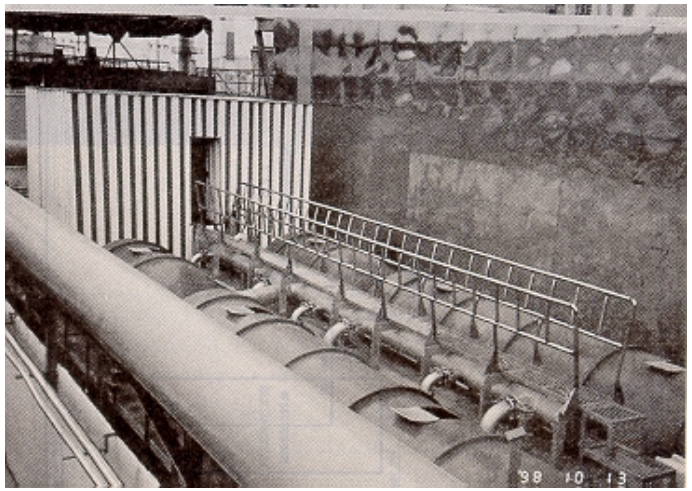
【 Schematic Diagram of Pilot Plant 】











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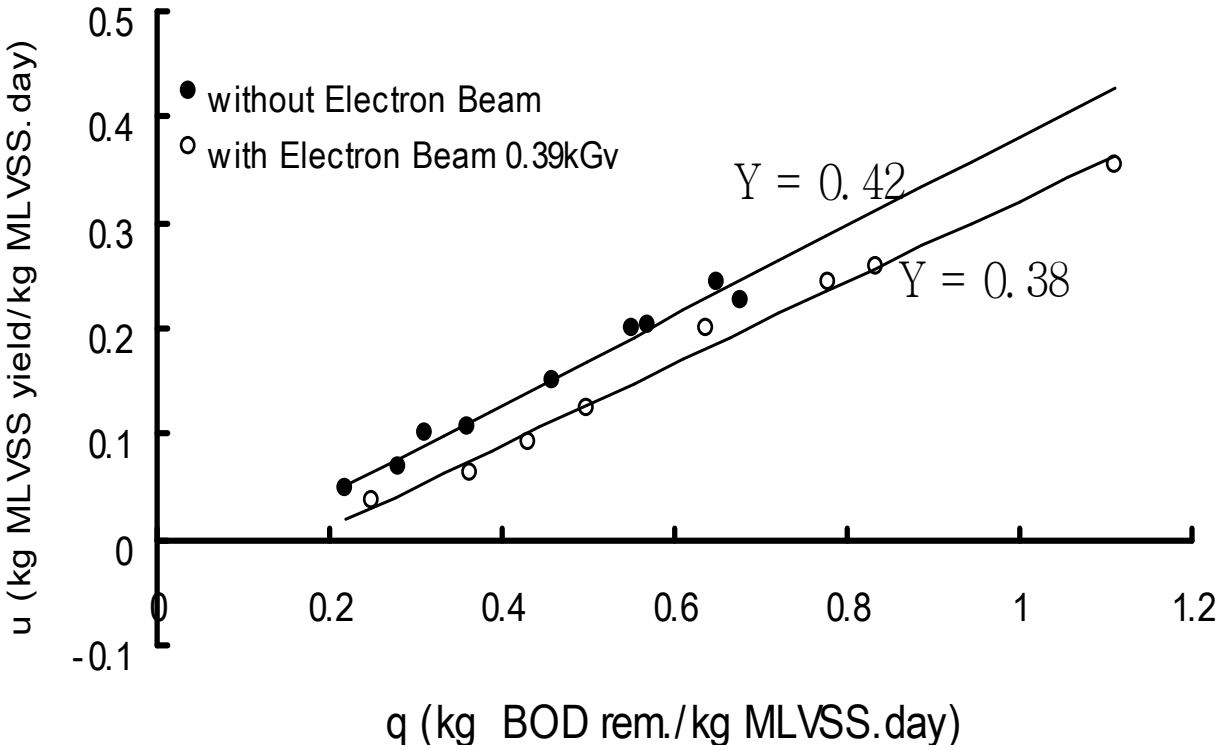
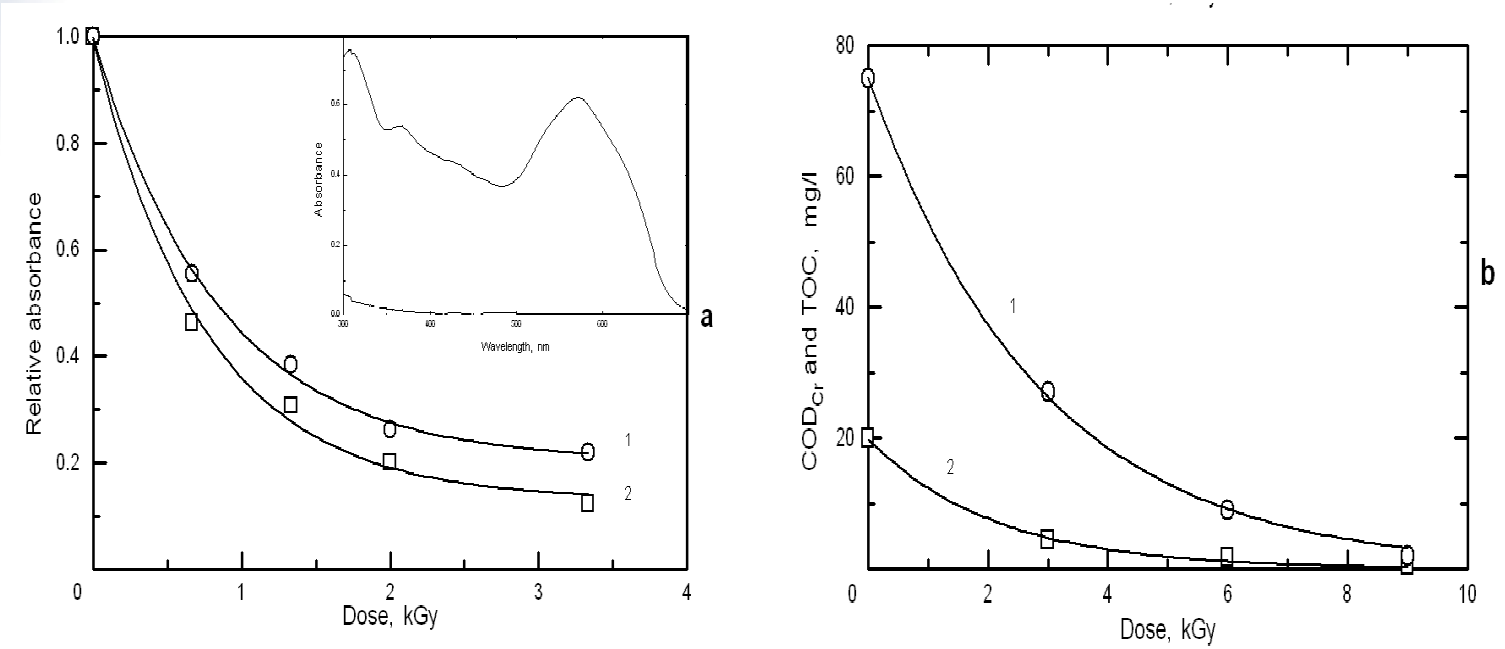
Daegu Dyeing Industrial Center

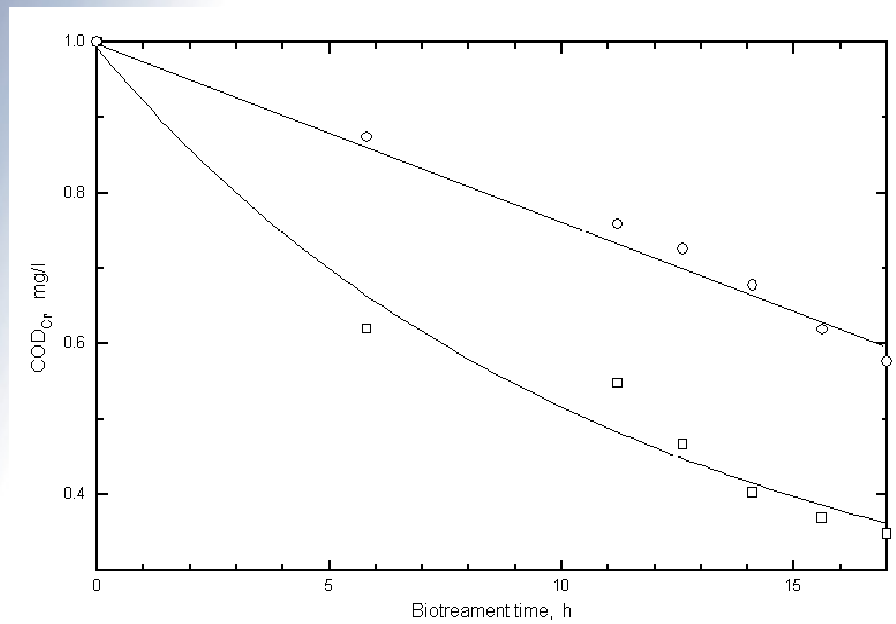


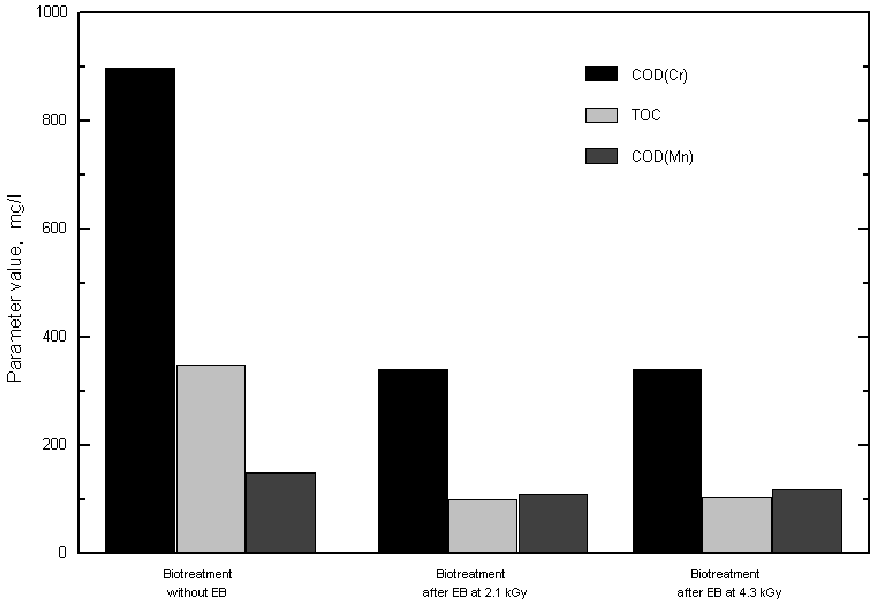
Sludge Conversion Rate from the organic Compounds



Degradation of acid red dye AB LDN in aqueous solutions (50 mg/l) upon electron-beam treatment:
a - decrease in relative absorbance at 570 nm with dose in deaerated (1) and aerated (2) solutions;
b - decrease in CODCr (1) and TOC (2) with dose in aerated solutions.

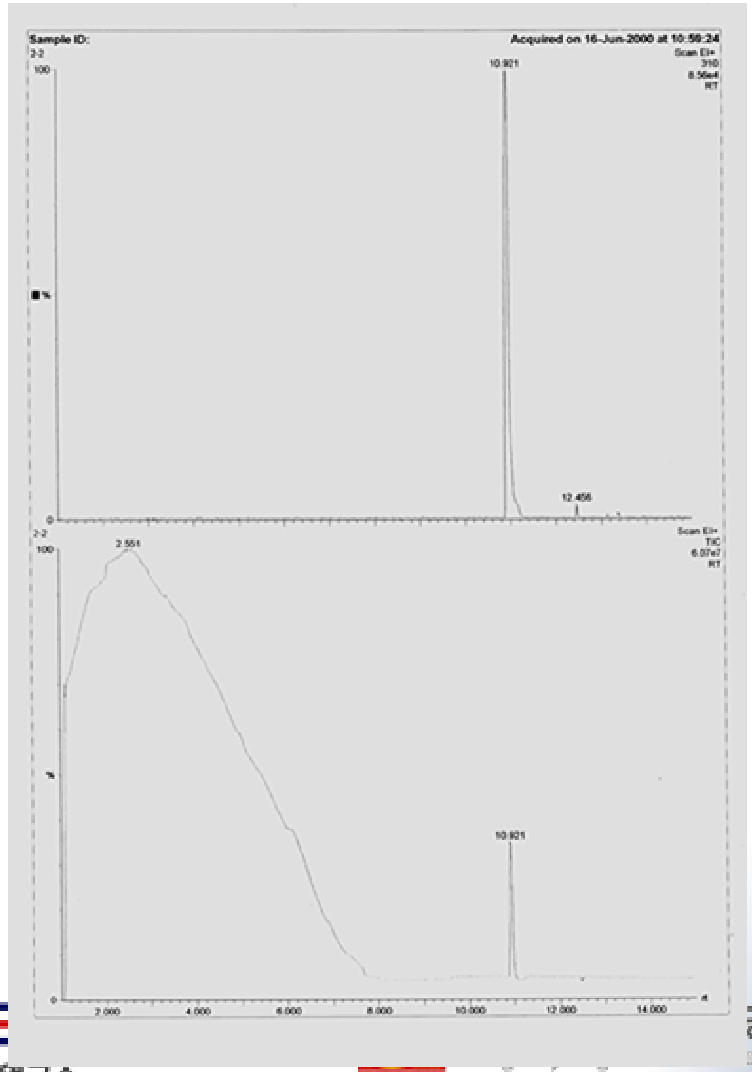
Insert in **a** - optical absorption spectra of the dye solution before and after irradiation at 9 kGy.





Effect of electron-beam treatment on biological treatment of dyeing wastewater:
a - kinetics of biotreatment of irradiated (*1*) and unirradiated (*2*) wastewater;
b - absorbed dose effect on combined electron-beam/biological treatment.

Effect of dose on TPA degradation (0.3 kGy)

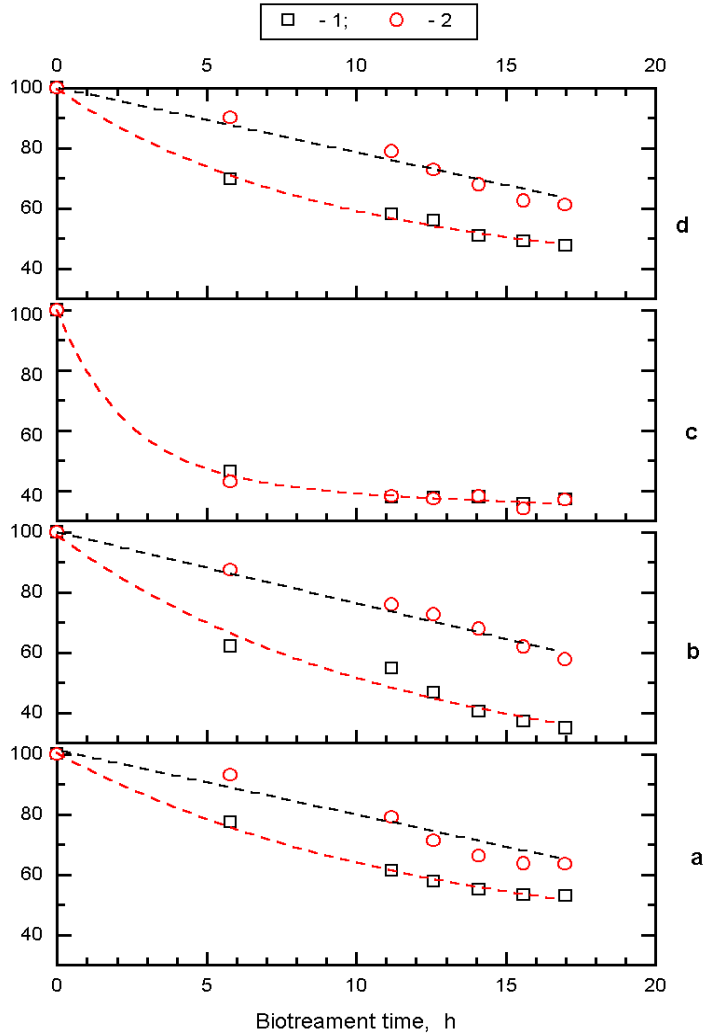


Effect of irradiation and biological treatment on wastewater parameters:

a-TOC; b-COD_{Cr}; c-COD_{Mn}; d-BOD.

1- after EB treatment

2- without EB treatment



1. Backgrounds

2. Pilot Plant Operation

3. Industrial Plant Construction

4. Future Prospects

Construction of Demonstration Facility

Industrial Plant for Treating Wastewater from Dyeing Process

- Decrease the Amount of Chemical Reagent up to 50%
- Improve the Efficiency of Biological Treatment by 30%
- Decrease the Retention time in Biological Treatment Facility

Characteristics of Industrial Plant

- Maximum flow rate of 10,000m^3/day with one 1MeV, 400kW accelerator
- Combined with existing Biological Treatment Facility

Construction Schedule

-The actual construction will start on Summer of 2004, and will finish by the middle of 2005. (Actual construction will be within 17 months)

Existing Problem :

The rapid growth in water demand needs to develop a water-efficient technologies including economical treatment methods of wastewater and polluted water. Even some pilot plants utilizing ionizing radiation for treating water and wastewater showed promising results, it is not realized due to the limitations to acceptance of this technology worldwide.

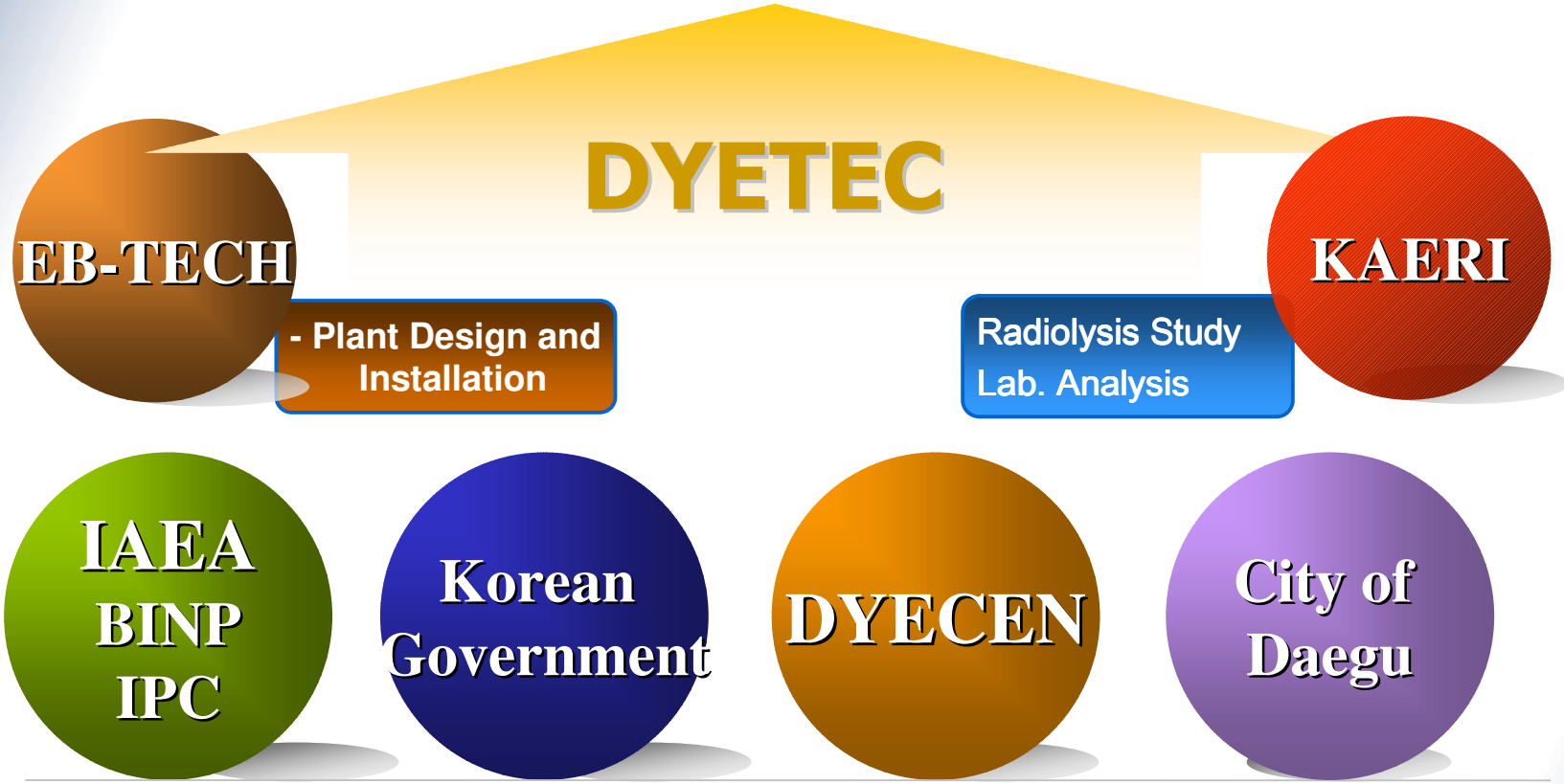
Therefore, to promote this technology, a demonstration facility under real industrial conditions with large scale, treating industrial effluent, should be constructed on the actual site of an industry

Objective :

To demonstrate the strong confidence in technological and economical advantages of treating water and wastewater with ionizing radiation

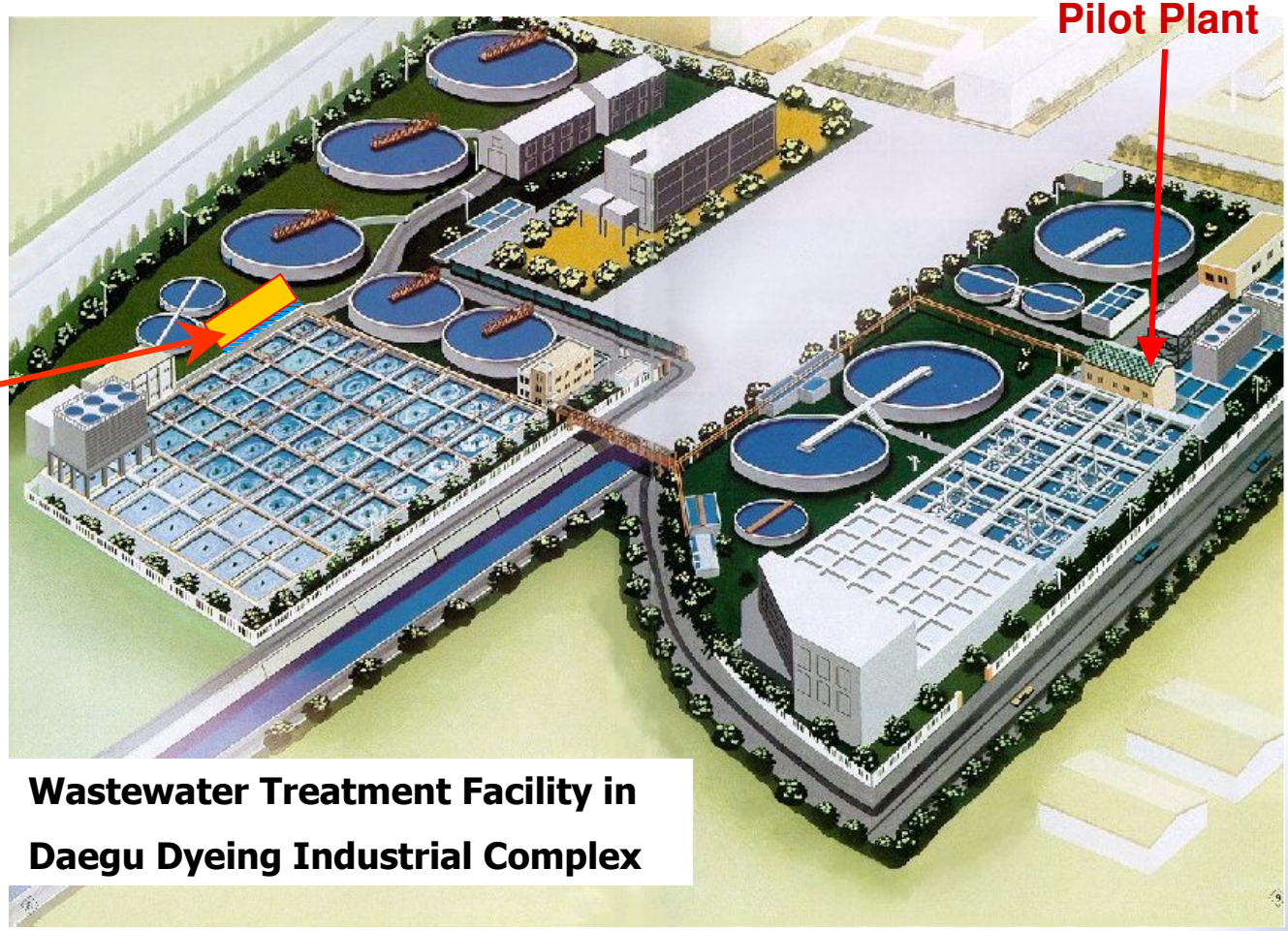
To promote the commercialization of e-beam wastewater treatment based on the result of Pilot Plant operation

To promote the peaceful use of ionizing radiation to the conservation of environment

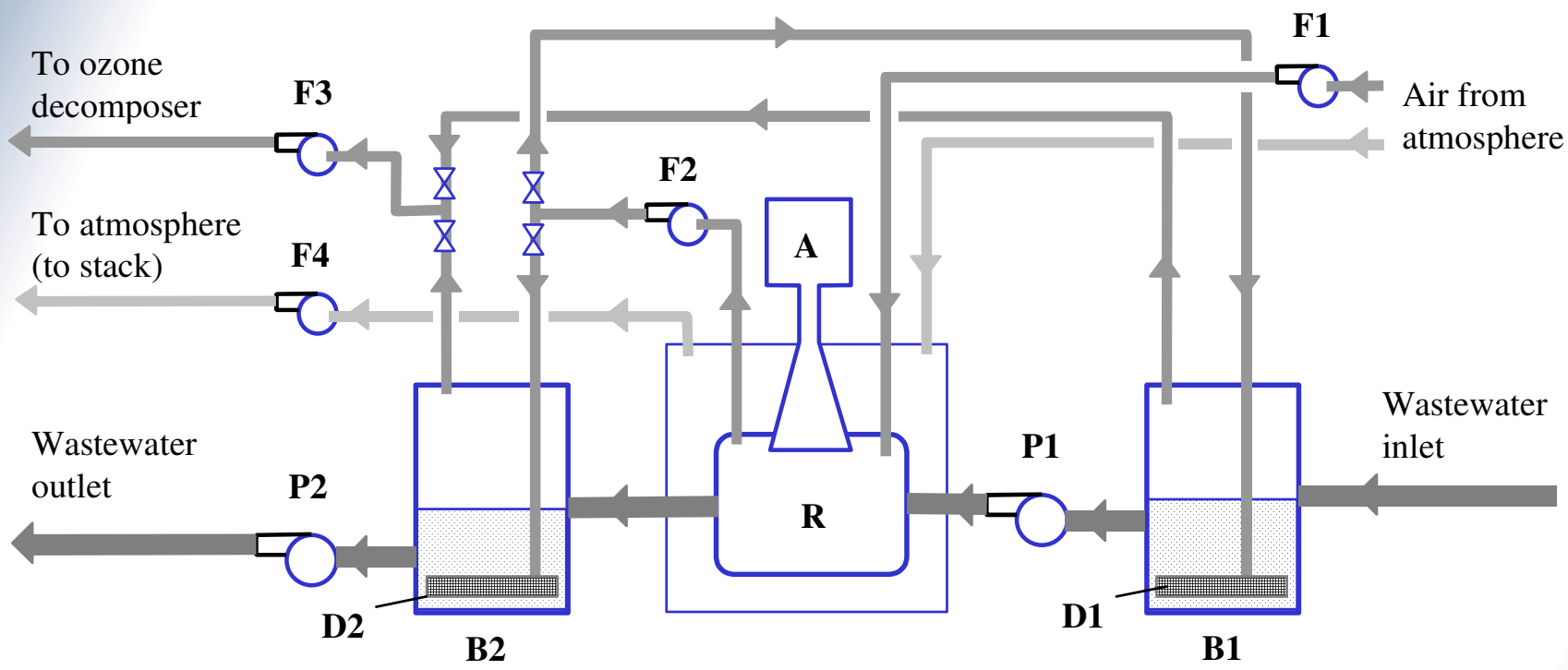

DYETEC
EB-TECH
- Plant Design and Installation
KAERI
Radiolysis Study
Lab. Analysis
IAEA
BINP
IPC
Korean Government
DYECEN
City of Daegu
-Technical Support
-Consulting
- Research Project
- Peaceful use of Radiation Technology
- Analysis of Economy
- Electric Power
- Bio-treatment
- Funding from Local Gov. Budget

Location of Pilot Plant

Industrial plant



Wastewater Treatment Facility in Daegu Dyeing Industrial Complex



Simplified technological scheme of the plant. F1-F4 – Air fans, P1-P2 – Water pumps, D1 and D2 – Diffusers, A – Accelerator, R – Reactor, B1 and B2 – Primary and secondary basins.

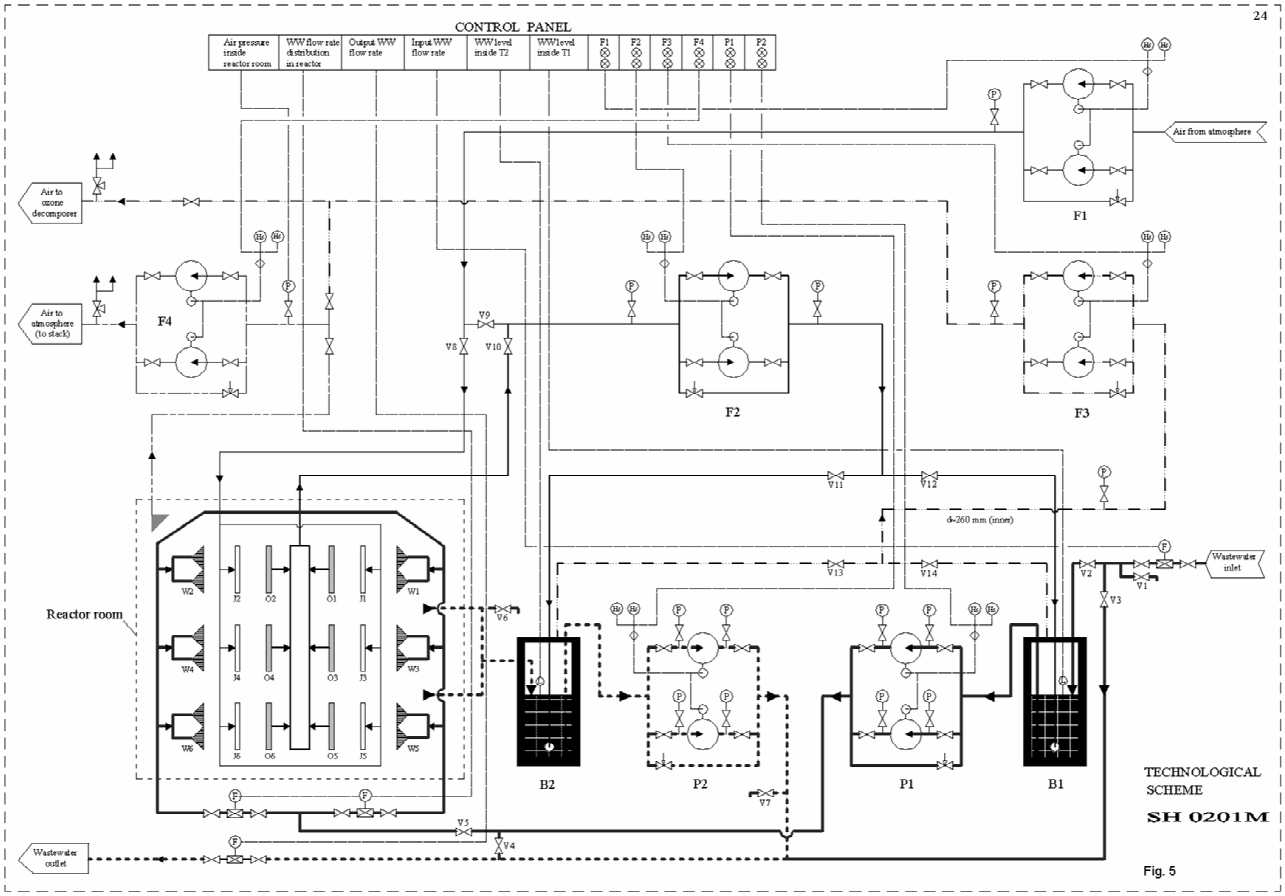
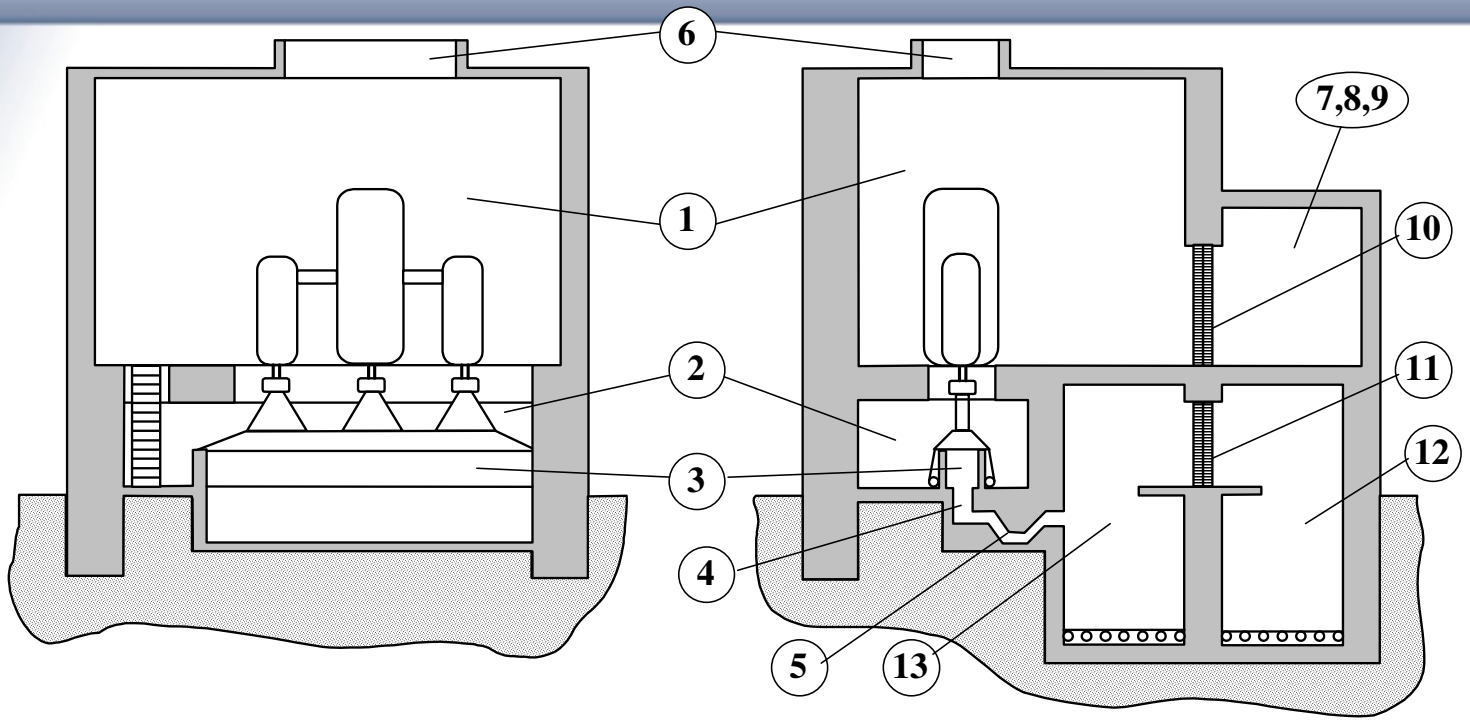
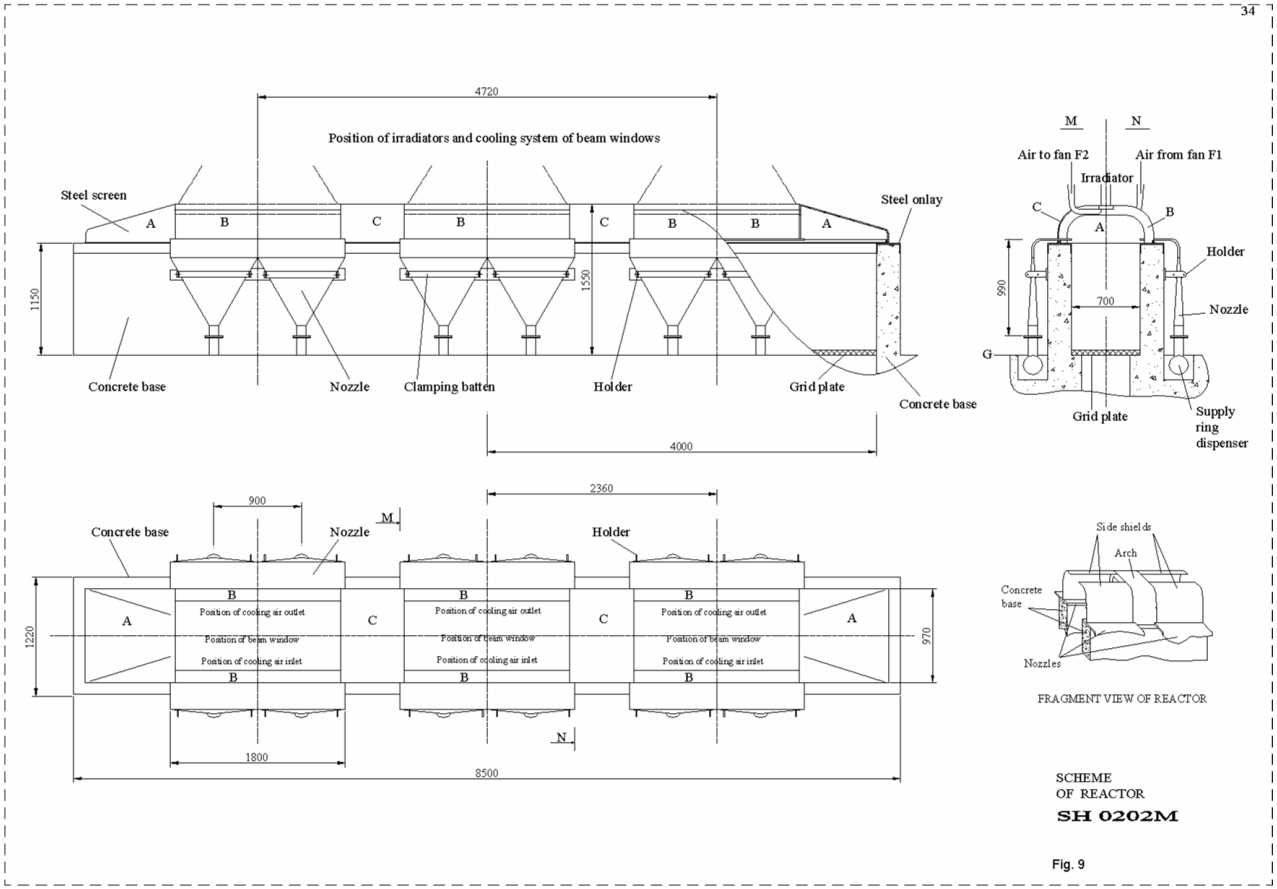
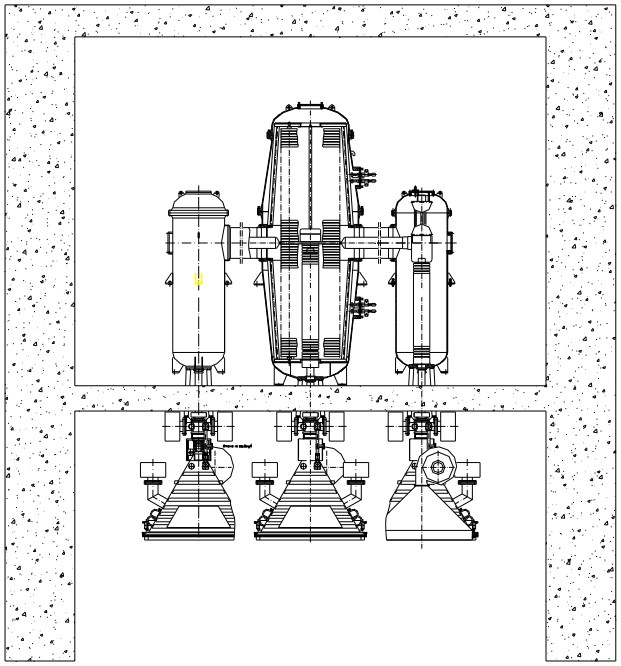

24
CONTROL PANEL
Air pressure inside reactor room
WW flow rate distribution in reactor
Output WW flow rate
Input WW flow rate
WW level inside T2
WW level inside T1
F1
F2
F3
F4
P1
P2
Air from atmosphere
Air to ozone decomposer
Air to atmosphere (to stack)
F1
F2
F3
F4
V1
V2
V3
V4
V5
V6
V7
V8
V9
V10
V11
V12
V13
V14
d=260 mm (inner)
Wastewater inlet
Wastewater outlet
Reactor room
W1
W2
W3
W4
W5
W6
J1
J2
J3
J4
J5
J6
O1
O2
O3
O4
O5
O6
B1
B2
P1
P2
TECHNOLOGICAL SCHEME
SH 0201M

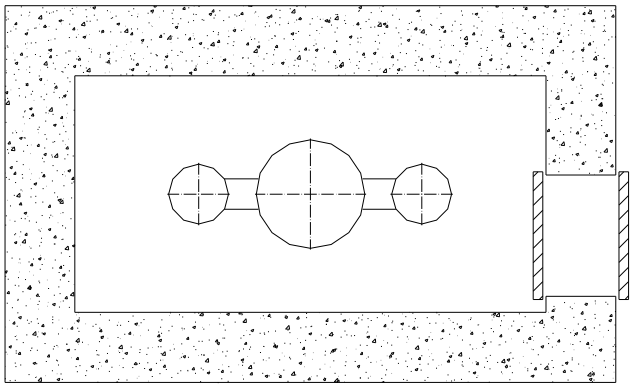
Fig. 5



1 - Accelerator/Generator Room, 2 - Reactor Room, 3 - Reactor, 4 - Collector, 5 - Reactor Output Channels, 6 - Ceiling Window, 7 - Instruments Room, 8 - Montage Area 9 - Control Room, 10 - Safe Door (First Floor), 11 - Safe Door (Ground Floor), 12 - Primary Basin, 13 - Secondary Basin. Entrance to building is by staircase to montage area on the first floor. Ceiling window may be used for primary installation of accelerator units into the building as well as for repair needs.

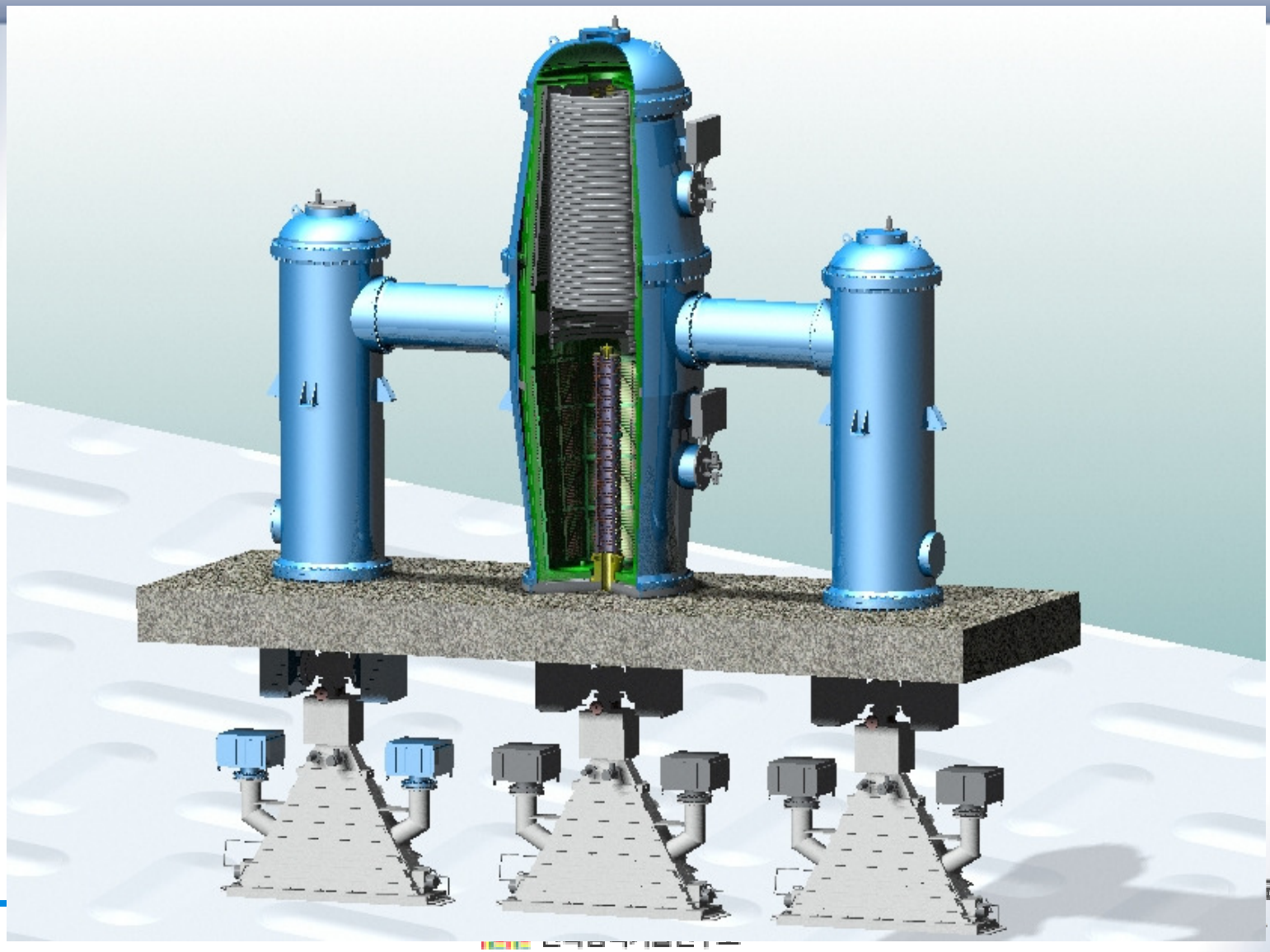

34
4720
Position of irradiators and cooling system of beam windows
Steel screen
Steel onlay
A
B
C
B
C
B
B
A
1150
1550
Concrete base
Nozzle
Clamping batten
Holder
Grid plate
Concrete base
4000
M
N
Air to fan F2
Air from fan F1
Irradiator
C
A
B
Holder
990
700
Nozzle
G
Grid plate
Supply ring dispenser
900
2360
Concrete base
Nozzle
M
Holder
B
A
C
Position of cooling air outlet
Position of beam window
Position of cooling air inlet
1220
970
N
1800
8500
Side shields
Arch
Concrete base
Nozzles
FRAGMENT VIEW OF REACTOR
SCHEME
OF REACTOR
SH 0202M
Fig. 9

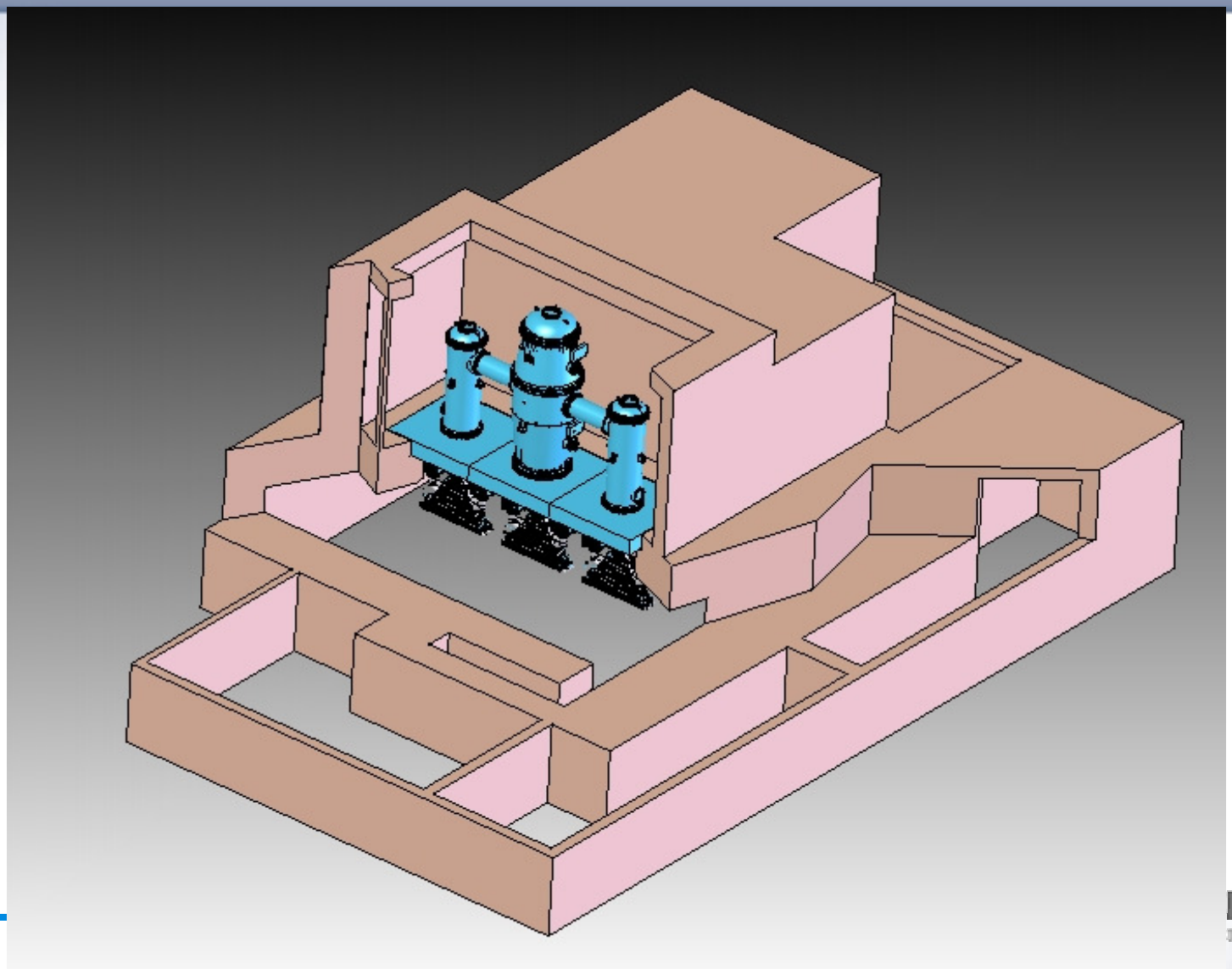


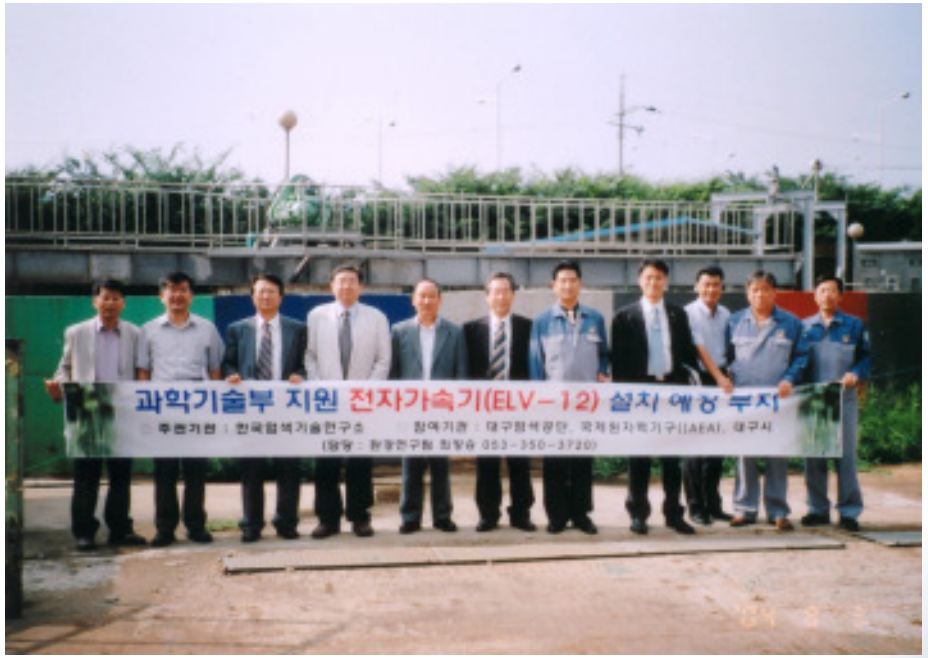


- Low level of radiation outside is provided by concrete walls and roof.

- The entrance of irradiation room is equipped by moving steel door or labyrinth. The labyrinth should provide passing of radiation through 3 reflection as minimum.







Place where the Building will be

Ground Breaking Ceremony





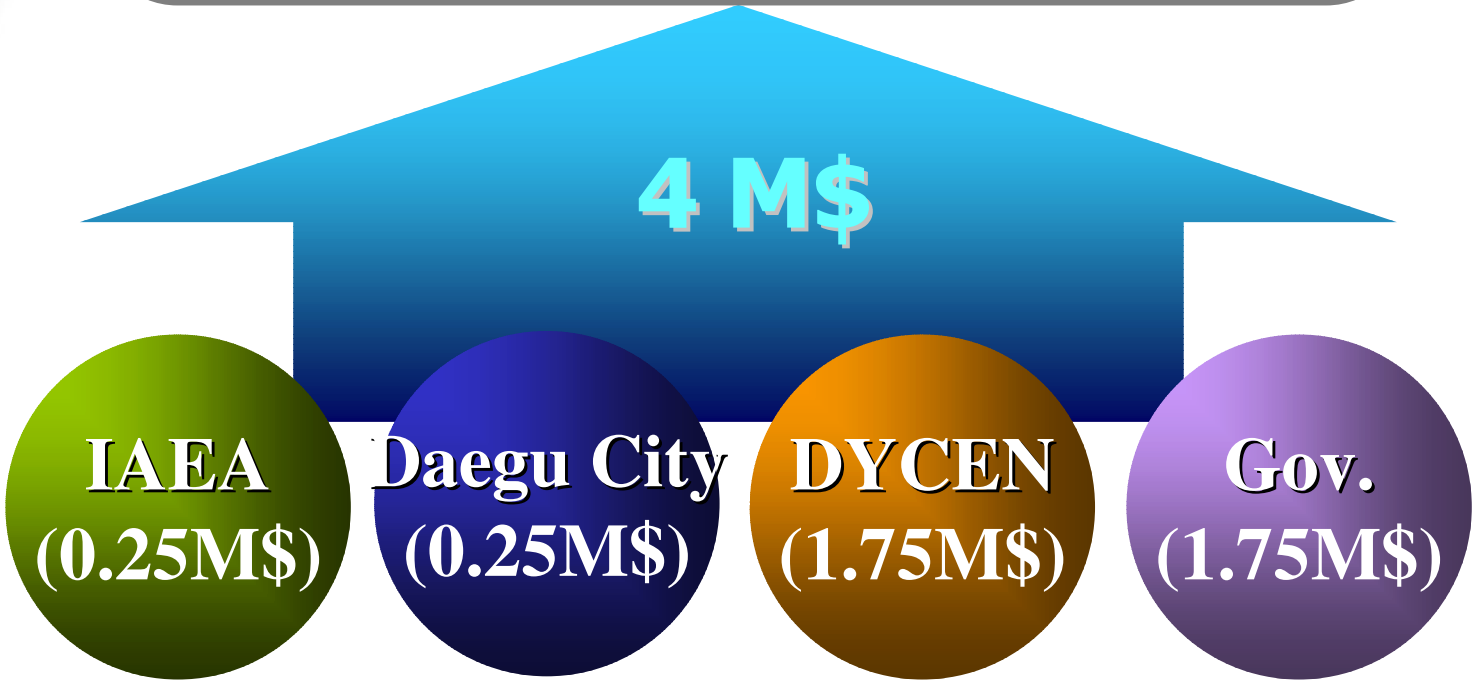
2005 4 26


2005 4 26


2005 4 26

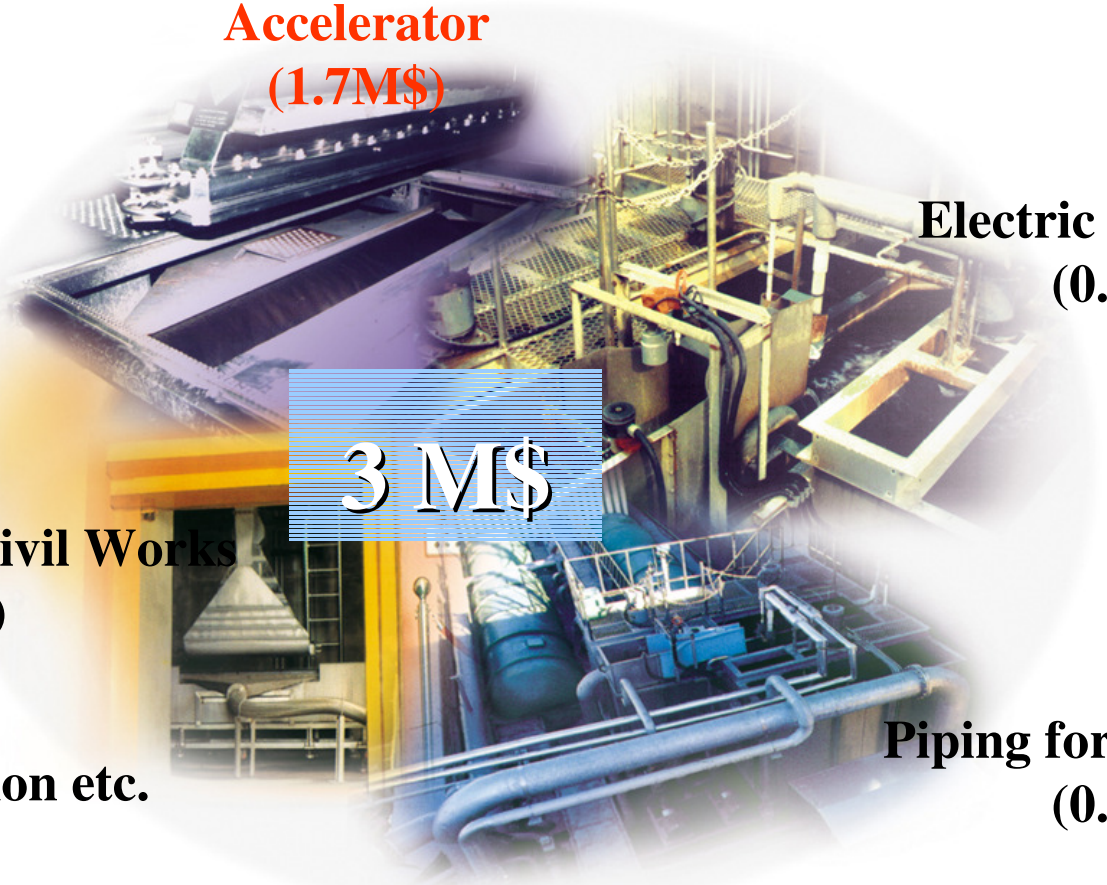

2005 4 27

EB Dyeing W/W Treatment Plant



Accelerator
(1.7M$)

Reactors
(0.1M$)



Electric Equipment
(0.3M$)

Shield Room & Civil Works
(0.5M$)

Ozone Ventilation etc.
(0.1M$)

Piping for Wastewater
(0.3M$)

Cost of Construction

Construction Cost of Industrial Plant

	Cost (M$)	remarks
Accelerator -. 400kW 1 MeV -. 3 irradiator (2m double window)	1.7	EB-TECH BINP
Reactor etc.	0.2	EB-TECH
Design	(0.3)	EB-TECH, IPC
Shield Room & Civil Works	0.5	DYECEN
Installation -. Piping, Electricity -. QA/QC/Inspection etc.	0.6 (0.2)	EB-TECH BINP DYETEC
Others -. Transportation -. Document Handling -. Tax, Insurance, etc.	(0.3)	EB-TECH, DYETEC
R & D	(0.2)	KAERI, IPC
Total	4.0	

Investment	Invest (k$) Interest Depreciation	- - -	3,000 240 150	 8% 20yr
Operation Cost (yr)	Chemicals Sludge Electricity	1,367 1,712 497	580 1,005 809	
	Total	3,576	2,784	
Quality of Effluent	COD BOD SS	80 30 30	60 20 20	
Others	The Investment will be returned in 5 yrs			

Economic Evaluation of Industrial Plant

Master Schedule

Project reporting (Dec. 2005)

Decision of Process (Mar. 2004)

Dec. 2003

Long-term Operation (Nov. 2005)

Basic Design (Mar. 2004)

Detail Design (May 2004)

Operation of Plant (July 2005)

Purchase Orders (Jul. 2004)

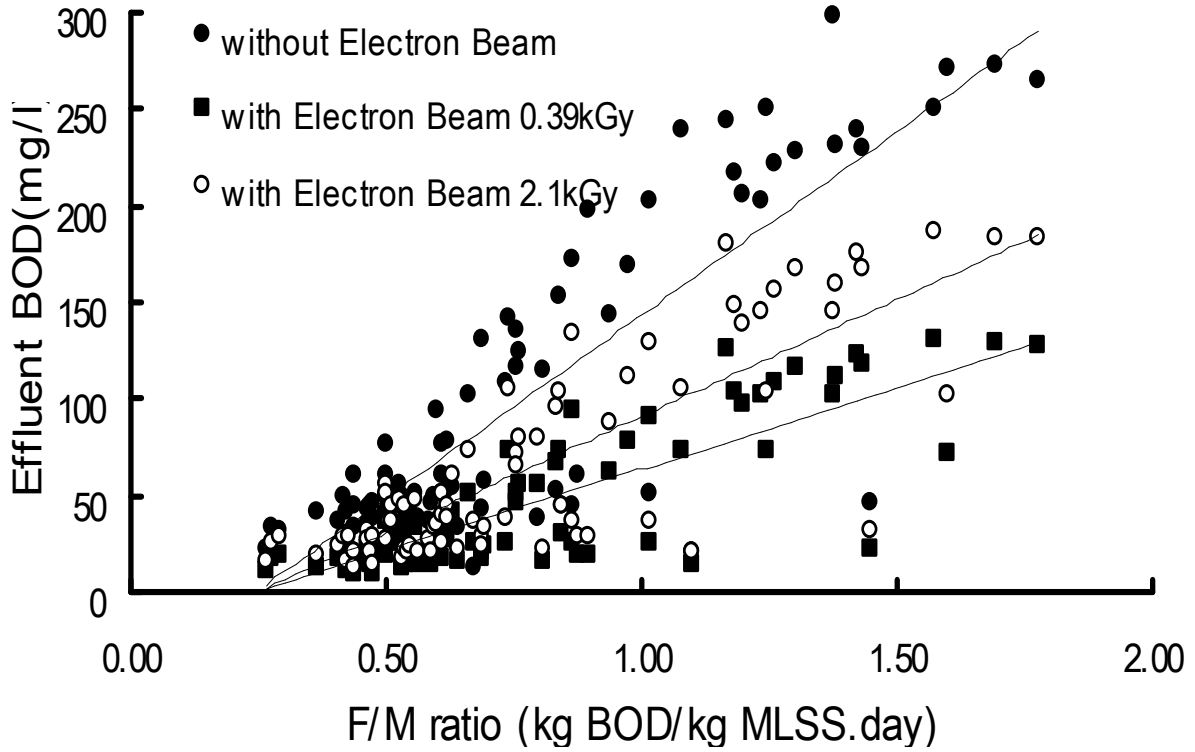
Shield Room Construction (Oct. 2004)

Dec. 2004

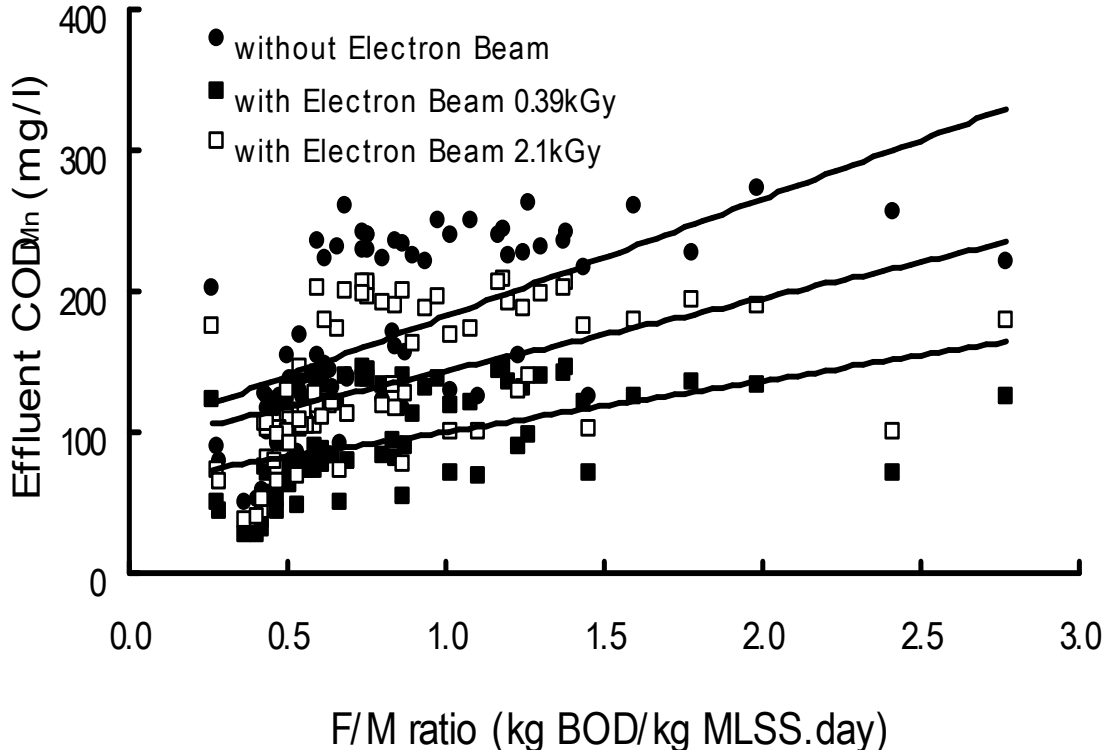
Installation of Accelerator (May. 2005)

Piping & Equipment (Nov. 2004)

We Believe Your Cooperation

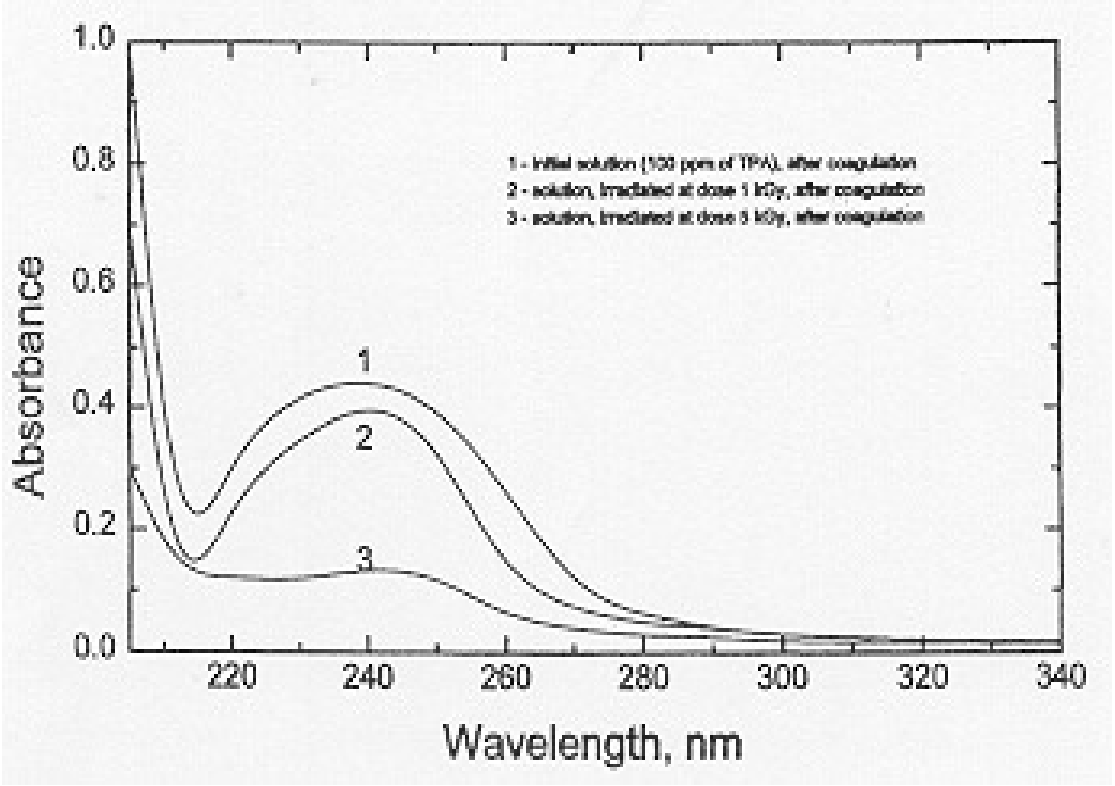


Profile of Effluent BOD from Biological Treatment



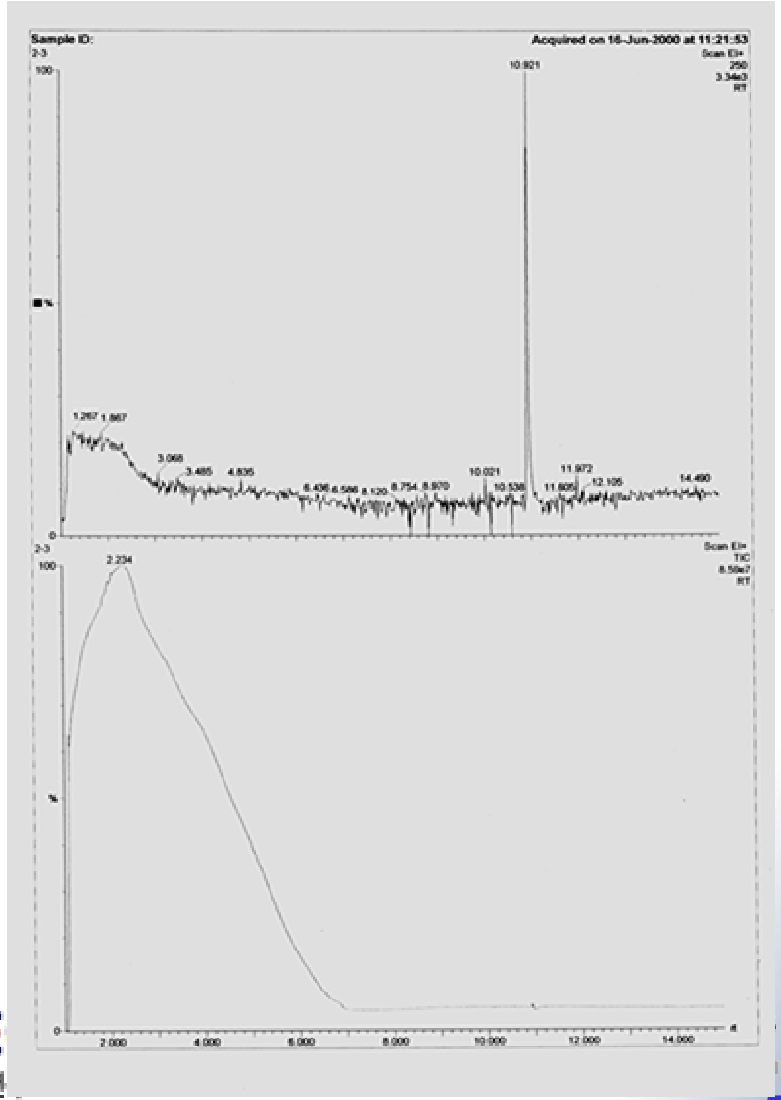
Profile of Effluent COD from Biological Treatment

Raw, 1kGy & 5kGy



Wavelength scan of TPA degradation

Effect of dose on TPA degradation (1.0 kGy)



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