REGULATIONS OF WASTEWATER DISCHARGE IN JAPAN

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How do we control wastewater discharge from industries in Japan?

Regulations must be efficient, fair and feasible!

- **Environmental water quality standards: EWQS**
  - **Targets for the control of wastewater discharge**
  - **Pollutants/parameters to be controlled**
- **National uniform effluent quality standards**

  cf. Total Maximum daily Loading: TMDL
- **Local rigorous effluent quality standards**
  - **Minimum requirement and local requirements/conditions for water environment**
- **Provisional effluent quality standards**

Water pollution by industrial wastewaters

Dokai Bay, Kita-Kyushu, Japan

ca. 1960s: Polluted

ca. 1990s: Restored

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Environmental Water Quality Standards (EWQS) : The Basic Law for Environment

- **Administrative targets and criteria for promotion of comprehensive measures against water pollution**
- **Water quality to be achieved and maintained in public water bodies**
  - ***To protect human health***
    - **To prevent health damages like Minamata and Itai-Itai diseases**
  - ***To conserve living environment***
    - **To protect all the water uses closely related with daily human life**
    - **To protect the living environment for plants/animals closely related to human life**

EWQS to Protect Human Health

(mg l^{-1} or less)

cadmium	0.003	1, 1, 1-trichloroethane	1.0
total cyanide	N.D.	1, 1, 2-trichloroethane	0.006
lead	0.01	trichloroethylene	0.03
chromium (VI)	0.05	tetrachloroethylene	0.01
arsenic	0.01	1, 3-dichloropropene	0.002
total mercury	0.0005	thiuram	0.006
alkyl mercury	N.D.	CAT (simazine)	0.003
PCB	N.D.	thiobencarb	0.02
dichloromethane	0.02	benzene	0.01
carbon tetrachloride	0.002	selenium	0.01
1, 2-dichloroethane	0.004	Nitrate and nitrite	10
1, 1 -dichloroethylene	0.02	fluoride	0.8
cis- 1, 2-dichloroethylene	0.04	borate	1.0
		1,4-dioxane	0.05

- **28 parameters on toxic substances**
- **Used and detected in Japanese water environment**

EWQS to Conserve Living Environment: Rivers

category	water use	pH	BOD	SS	DO	CG*
AA	Water supply class 1 ; conservation of natural environment, and uses listed in A-E	6.5-8.5	1	25	7.5	50
A	Water supply class 2 ; fishery, class I; bathing and uses listed in B-E	6.5-8.5	2	25	7.5	1,000
B	Water supply class 3 ; fishery, class 2, and uses listed in C-E	6.5-8.5	3	25	5	5,000
C	Fishery class 3 ; industrial water, class I, and uses listed in D-E	6.5-8.5	5	50	5	-

- **Main target = Organic pollution (BOD) + turbidity, sanitation**
- **Six categories dependent on water uses: AA, A, B, C, D, E**
  water supply, fishery, bathing, irrigation, conservation

Categories in Ohta River, Hiroshima (River , Estuary)

EWQS to Conserve Living Environment: Lakes and Reservoirs

(volume > 10 million m^3)

category	water use	pH	COD_{Mn}	SS	DO	CG*
AA	water supply class 1, fishery class 1, conservation of natural environment, and uses A-C	6.5-8.5	1	1	7.5	50
A	water supply class 2 and 3, fishery class 2, bathing, and uses B-C	6.5-8.5	3	5	7.5	1,000
B	fishery class 3, industrial water class 1, irrigation water, and use C	6.5-8.5	5	15	5.0	-
C	industrial water class 2, conservation of environment	6.0-8.5	8	**	2.0	-

*number of coliform groups (MPN/100 ml), **no floating matters

(mg l^{-1})

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EWQS on Nitrogen and Phosphorus for Lakes and Reservoirs: Eutrophication

Category	water use	T-N	T-P
I	Conservation of natural environment, and uses listed in II-V	0.1	0.005
II	Water supply classes 1, 2, 3 ((except for special types), fishery class 1, bathing; and uses listed in III-V	0.2	0.01
III	Water supply class 3 (special types), and uses listed in IV-V	0.4	0.03
IV	Fishery class 2, and uses listed in V	0.6	0.05
V	Fishery class 3, industrial water; agricultural water; conservation of living environment	1.0	0.1

EWQS to Conserve Living Environment: Estuaries

category	water use	pH	COD_{Mn}	CG	NHE*
A	fishery calss 1, bathing, conservation of natural environment and uses B-C	7.8-8.3	2.0	1,000	ND
B	fishery calss 2, industrial water and uses B-C	7.8-8.3	3.0	-	ND
C	conservation of environment	7.0-8.3	8.0	-	-

*NHE: n-Hexane Extracts

EWQS on Nitrogen and Phosphorus for Estuaries : Eutrophication

category	uses of water	T-N	T-P
I	Conservation of natural environment and II, III, IV	0.2	0.02
II	Fisheries class 1, Marine recreation / bathing and III, IV	0.3	0.03
III	Fisheries class 2 and IV	0.6	0.05
IV	Fisheries class 3, Protection of benthic organisms, Industrial water supply	1.0	0.09

(mg l^{-1})

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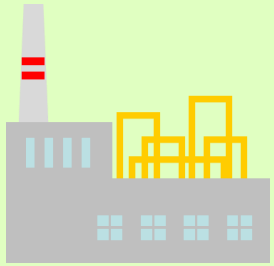
How to satisfy with the EWQS: C_t ?

C_e : effluent water quality standards (concentration)



industry

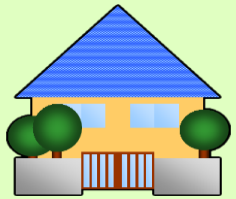
C_{in}

Wastewater treatment plants

C_e

- *To what extent purify effluents?*
- *Take self-purification into consideration?*
- *The same for industries and domestic?*

self-purification



household

C_{in}

Wastewater treatment plants

$C_e \fallingdotseq 10 \times C_t$

or

$C_e \fallingdotseq C_t$

C_t

self-purification

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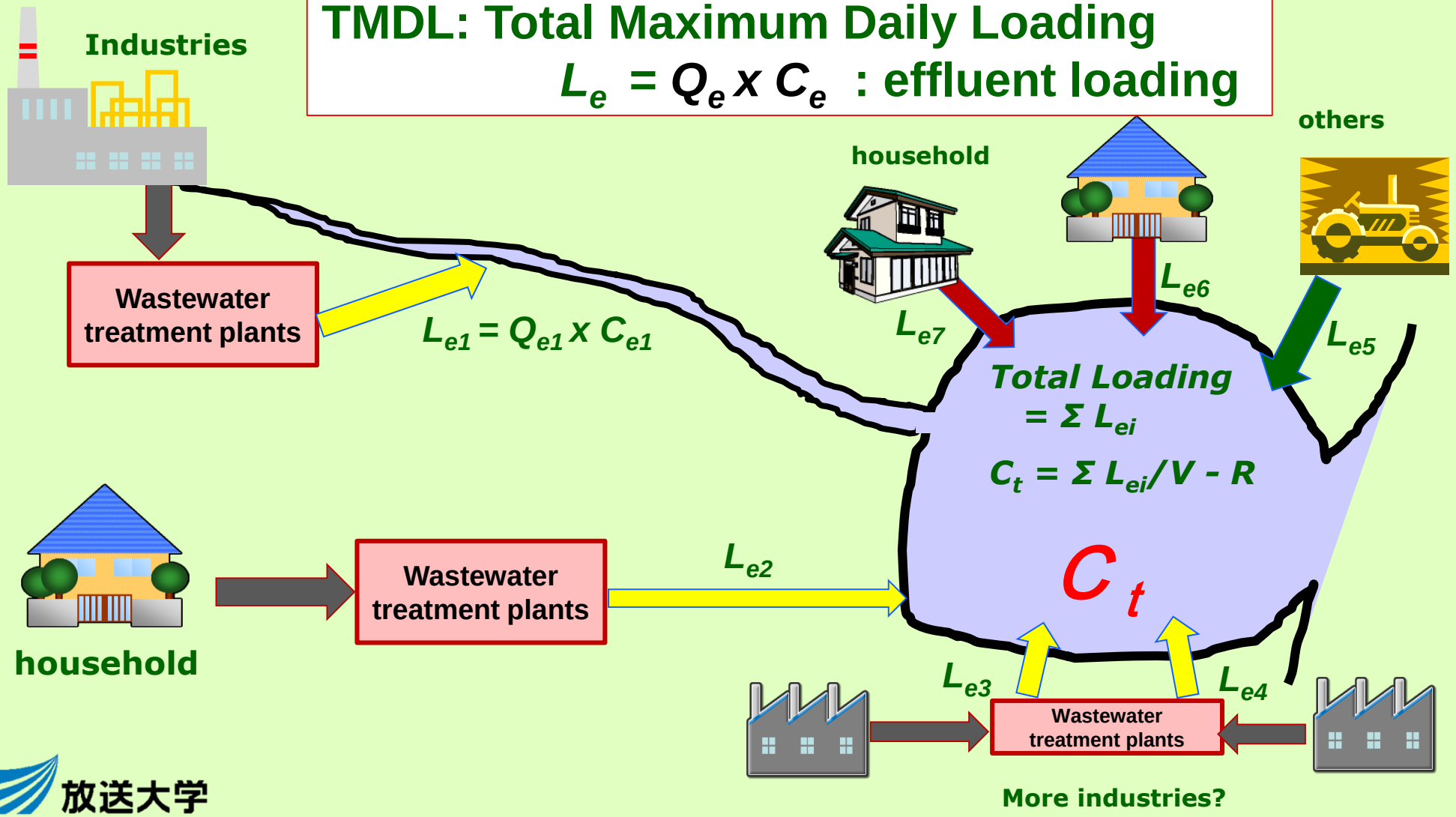
How to satisfy with the EWQS: C_t ?

TMDL: Total Maximum Daily Loading

$L_e = Q_e \times C_e$: effluent loading



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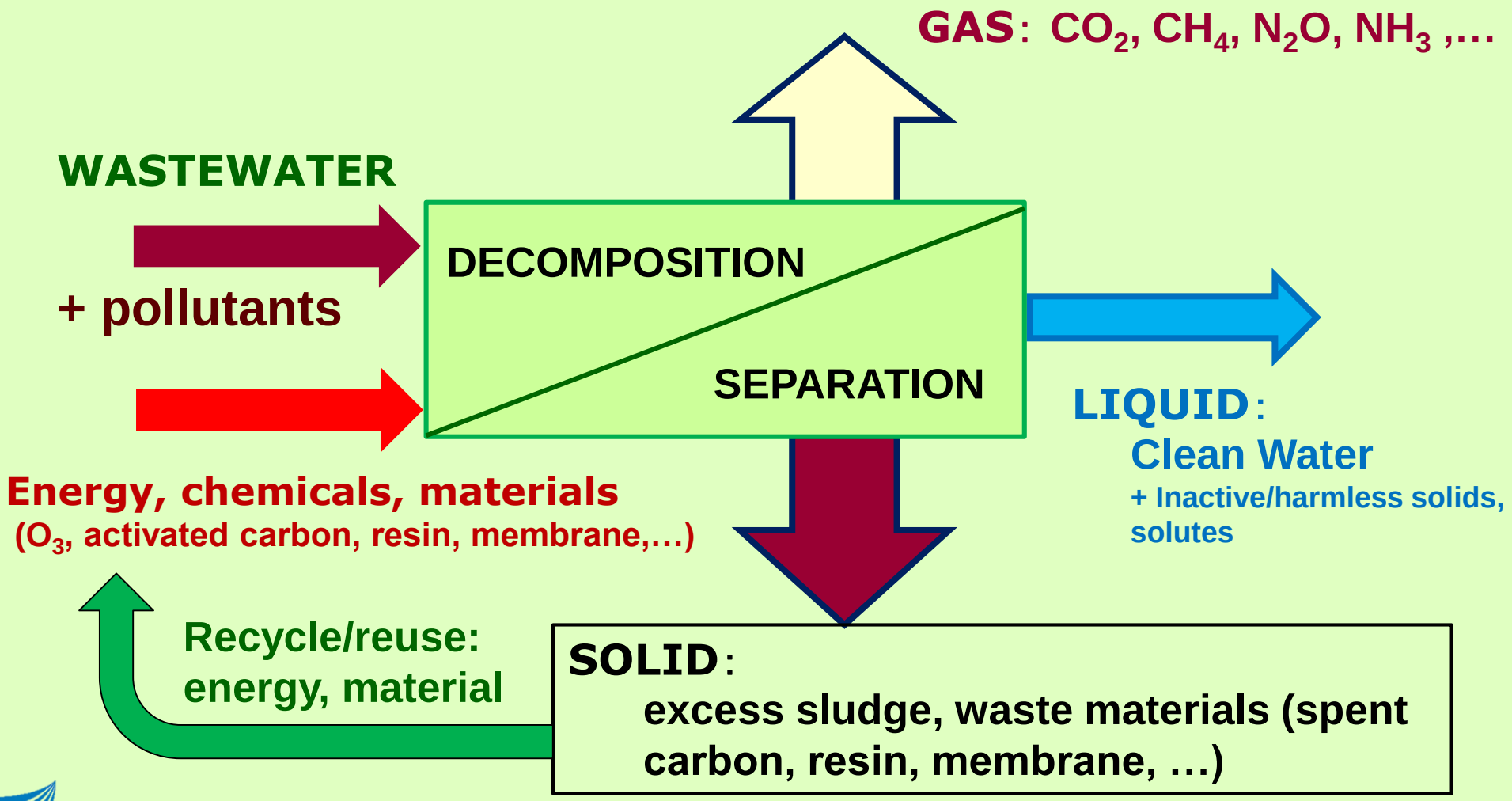
WASTEWATER TREATMENT TECHNOLOGY



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Water quality of effluent?

Complete removal of pollutants from wastewaters?

- **(Technically) feasible by advanced treatment, i.e. ozone, UV, activated carbon, …..**
- **Too much to satisfy with EWQS?**
- **Waste of energy, chemicals, materials and funds may result in other problems, i.e. climate change, waste disposal and bankruptcy, ……**

Appropriate removal of pollutants from wastewater!

Efficient : enough to satisfy with EWQS

Fair : equivalent efforts among polluters

Feasible : the best available technology

NATIONAL UNIFORM EFFLUENT QUALITY STANDARDS

- Uniform and national minimum criteria for effluent quality
- Regulate effluent discharges into public water bodies from the specified facilities (ca. 600 industrial categories).
- Parameters to be controlled
  - Human health : all facilities
  - Living environment : daily discharge > 50 m^3

Exemption from the standards for small industries = Fair

- Feasible: small budget, lack of human resources
- Effective: Little environmental impacts

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NATIONAL UNIFORM EFFLUENT QUALITY STANDARDS

Parameters on human health

cadmium & compounds	0.03	trichloroethylene	0.03
total cyanide	1.0	tetrachloroethylene	0.1
organophosphorus compounds	1.0	1, 3- dichloropropene	0.02
lead & compounds	0.1	thiuram	0.06
chromium (VI) & compounds	0.5	CAT (simazine)	0.03
arsenic & compounds	0.1	thiobencarb	0.2
total mercury	0.005	benzene	0.1
alkyl mercury	N.D.	selenium & compounds	0.1
PCBs	0.003	fluoride & compounds	estuaries 15, others 8
dichloromethane	0.2		
carbon tetrachloride	0.02	borate & compounds	estuaries 230, others 10

- **Effluent quality standard = EWQS x 10**
  - **Ten times dilution after discharge?**
  - **Enough to satisfy with EWQS by self-purification?**
- **Uniform to all the facilities**

NATIONAL UNIFORM EFFLUENT QUALITY STANDARDS

Parameters on living environment

parameters	standard values (mg l^{-1} or less)
pH	5.8-8.6
BOD, COD_{Mn}	160 (daily average = 120)
SS	200 (daily average = 150)
n-hexane extract	5.0 (mineral oil), 30 (animal fat and vegetable oil)
phenols	5.0
copper	3.0
zinc	5.0
dissolved Fe, Mn	10.0, 10.0
chromium	2.0
fluorine	15

- **Fair: Industrial effluents must be equivalent with conventional domestic wastewater**
  - **BOD, COD = 160 mg l^{-1}, SS = 200 mg l^{-1}**
- **Small exemption**

Local Rigorous Effluent Quality Standards

- **Local (prefecture) ordinance for local requirements**
  - **if the national uniform effluent quality standards are not enough to satisfy with the EWQS for a specific local water body**
- **All the local governments have put standards in force**

Local Rigorous Effluent Quality Standards by Prefectural Governments : COD_{Mn}

prefecture	water area	new	operating
Kanagawa	A: protected lakes	5 (3)	20 (15)
	A: other lakes	15(10)	25 (20)
	B	25 (20)	60 (50)
	marine	25 (20)	60 (50)
Shiga		15-120	20-120
Hiroshima	first category	50 (40)	
	second category	85 (65)	
	third category	120 (90)	
	forth category	130 (100)	

Different standards among:

Efficient, Fair, Feasible

- **Prefecture, water area to satisfy with EWQS**
- **New and operating facilities**

Local Rigorous Effluent Quality Standards by Shiga Prefectural Government : T-N, T-P

industry	Daily volume of discharge (m^3)	operating		new	
		T-N	T-P	T-N	T-P
food (except for box lunch production)	10 - 30	40	8	30	2
	30 - 50	25	4	20	2
	50 - 1,000	20	3	12	1.5
	1,000 -	15	2	10	1
textile	10 - 30	40	6	30	2
	30 - 50	15	2	12	1.2
	50 - 1,000	12	1.5	8	0.8
	1,000 -	10	1	8	0.5
	10 - 30	40	2	20	2
	30 - 50	15	1.5	12	1
NATIONAL UNIFORM STANDARDS		120(60)	16(8)	120(60)	16(8)

(mg l^{-1})

Different standards among:

- **Industrial categories**
- **Daily volume of discharge**
- **New and operating facilities**

Efficient, Fair, Feasible

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Provisional effluent quality standards

- Some industries are difficult to comply with the national uniform effluent quality standard even with the best available technology
- Exemption from the national uniform standards for the specified industries: N:55, P:39
  - National uniform: N(120, 60), P(16, 8) : (daily maximum, average), mg l^{-1}
  - pig/cattle farm: N (700,350), P (100,50)
  - coke oven: N (170,130)
  - dairy products: P (30,15)
- Specified industries must develop and adopt a new technology to satisfy with the national uniform standards in 5 years (1993-1998)

PROVISIONAL STANDARDS FOR FOOD INDUSTRIES

	code	T-N		T-P	
		max.	ave.	max.	ave.
meat processing	1211	140	70	140	70
dairy products	1212	-	-	30	15
other livestock products	1219	140	70	60	30
fish canning, bottling	1221	440	220	100	50
seaweed processing	1222	180	90	60	30
fish ham/sausage	1224	260	130	160	80
fish paste (boiled)	1225	460	230	320	160
frozen fish products	1226	360	180	140	70
frozen fish processing	1227	460	230	320	160
other fish products	1229	380	190	340	170
soy source and amino acds	1242	480	240	-	-
synthetic seasoning	1243	480	240	-	-
beet sugar refinary	1251	260	130	50	25
fresh cake	1272	-	-	60	30
veqetable oil	1281	-	-	100	50
animal oil	1282	180	90	100	50

Different standards among:

- **Industrial categories**

Efficient, Fair, Feasible

REVISION OF THE PROVISIONAL STANDARDS

- **PROVISIONAL STANDARDS:**
  - **1993.10-1998.9**
- **The 1st revision: 1998.10-2003.9**
  - **N: 50 INDUSTRIES ⟶ 4 INDUSTRIES**

    2,851 plants ⟶ 115 plants
  - **P: 34 INDUSTRIES ⟶ 3 INDUSTRIES**

    2,512 plants ⟶ 117 plants
- **The 2nd revision: 2003.10-2008.9**

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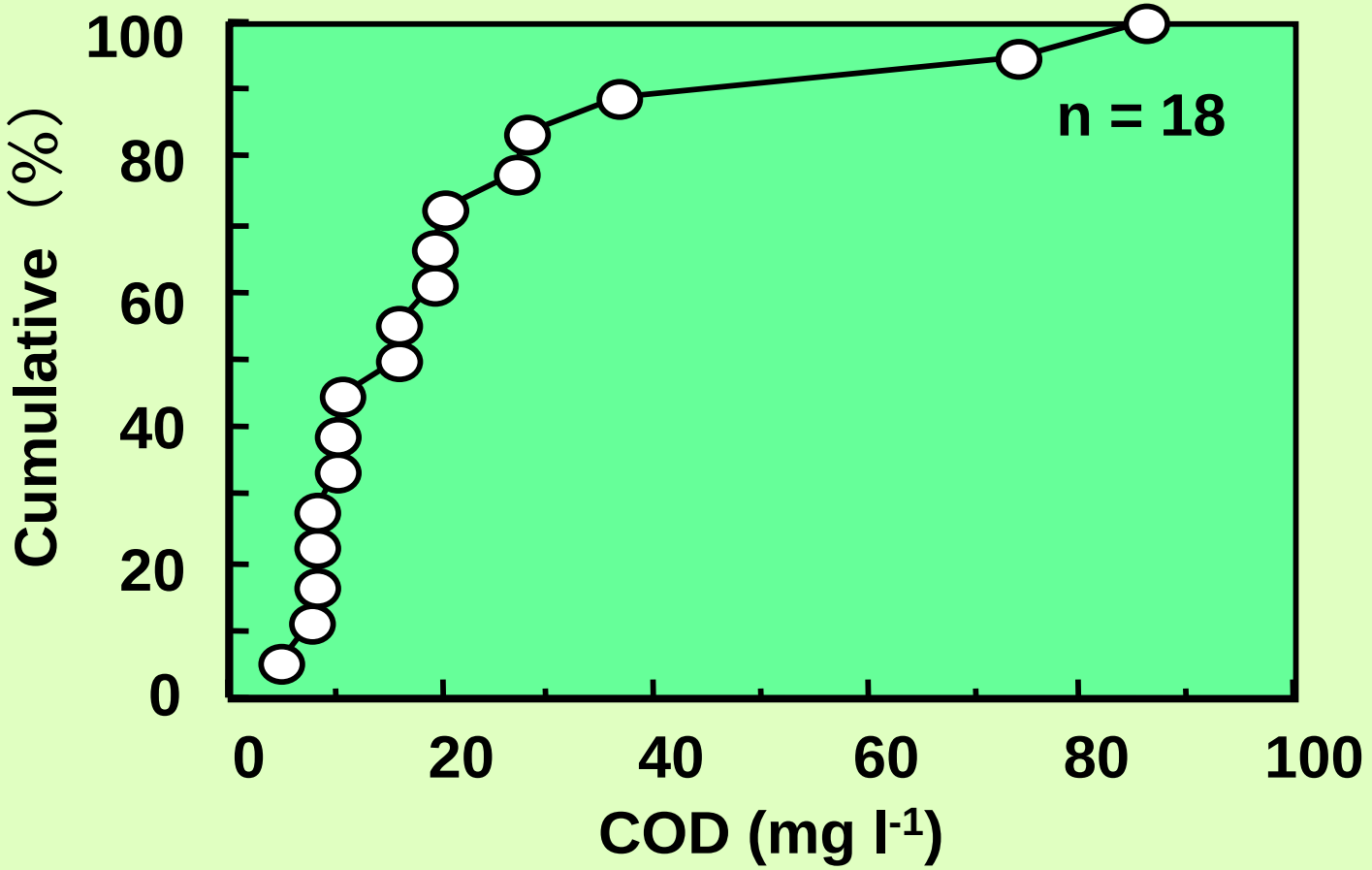
REVISIONS OF PROVISIONAL STANDARDS

National uniform: N(120, 60), P(16, 8)

	Industrial categories	Provisional standard (1993-1998)	1st revision (1998-2003)	2nd revision (2003-2008)	3rd revision (2008-2013)	4th revision (2013-2018)
N	Natural Gas	200 (180)	170 (150)	160 (150)	160 (150)	160 (150)
	Feedlot	270 (350)	260 (200)	190 (150)	190 (150)	170 (140)
	Silver Oxide	560 (370)	350 (300)	240 (210)	-	
	Cobalt Oxide		1100 (880)	900 (750)	550 (300)	400 (120)
	Lead Chromate Paint		1,500 (1,000)	1,300 (950)	-	
	Vanadium & Molybdenum Compounds	26,000 (17,000)	8,000 (6,000)	6,000 (5,000)	5,000 (3850)	4,250 (3,500)
P	Feedlot	100 (50)	50 (40)	30 (24)	30 (24)	20 (15)
	Phosphorus and Compounds	640 (280)	90 (40)	40 (10)	40 (10)	-

EFFLUENT COD FROM SWEET BEAN PROCESSING PLANTS

Different effluent quality in the same industrial categories, i.e. the same products from similar raw materials



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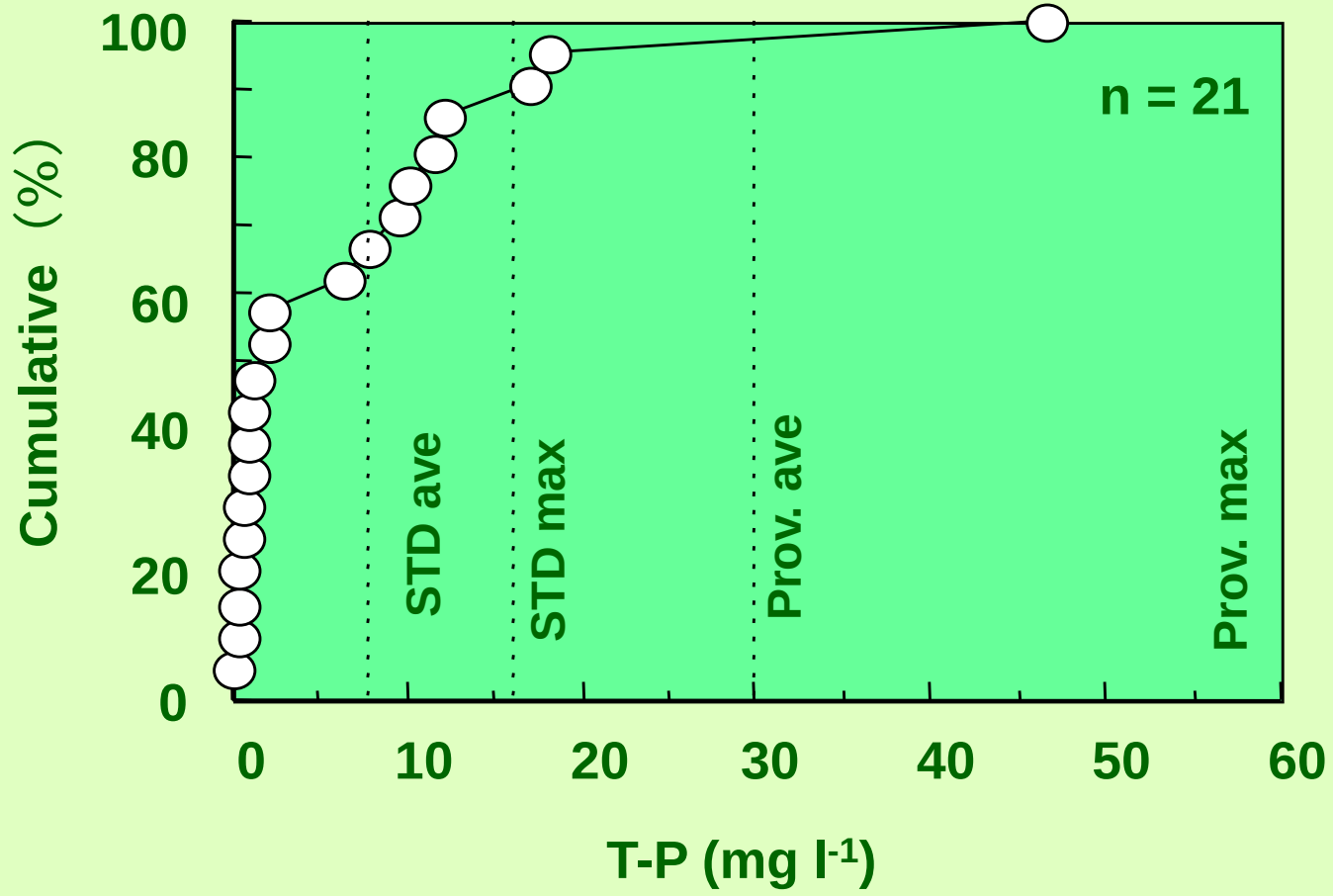
EFFLUENT T-P FROM SWEET BEAN PROCESSING PLANTS

The provisional standards to save all the facilities is necessary?



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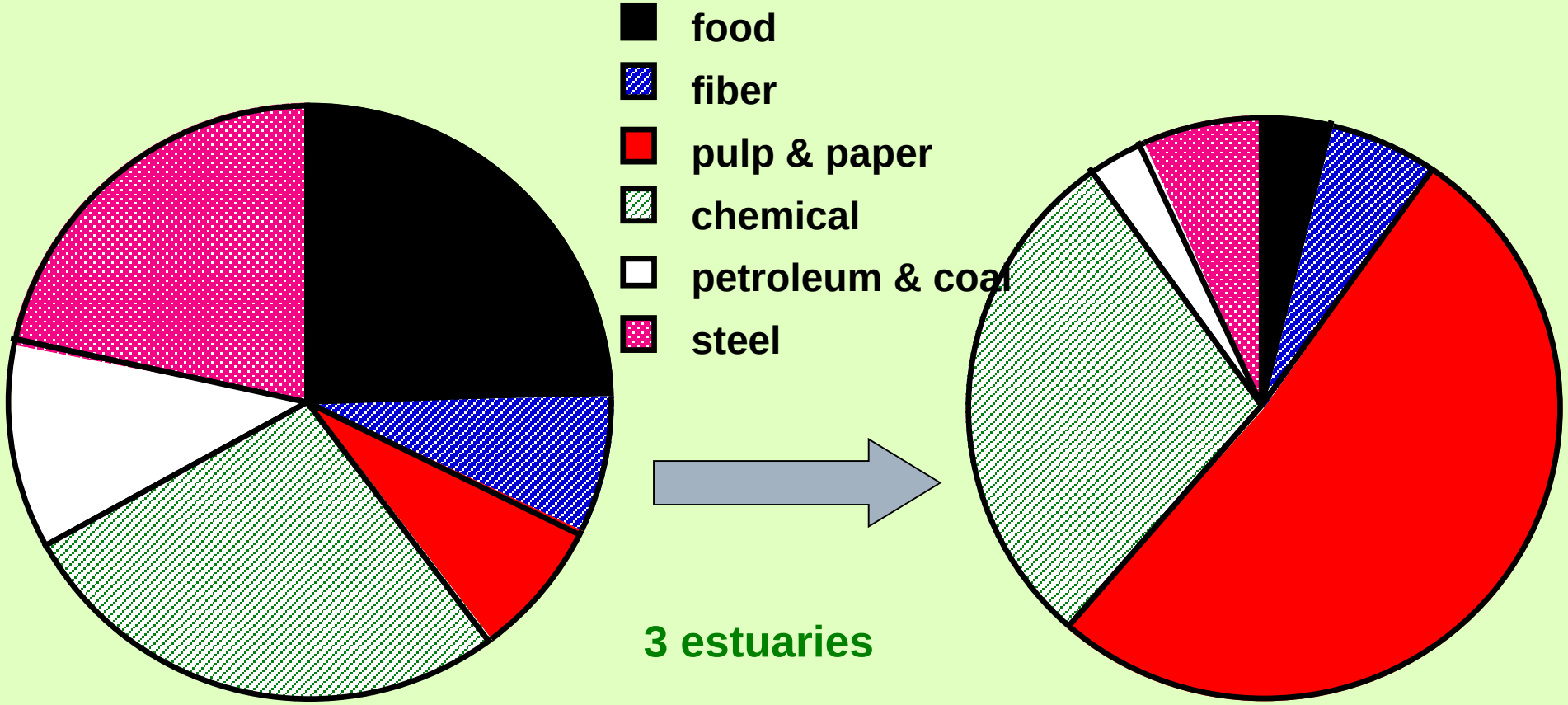
Time for Q & A

Seto Inland Sea
Akitsu, Higashi-Hiroshima

PRODUCTION AND LOADINGS FOR 6 MAJOR INDUSTRIES: 1992



Total Production：¥ 57.8 trillion

Total loading : 274 t day^{-1}

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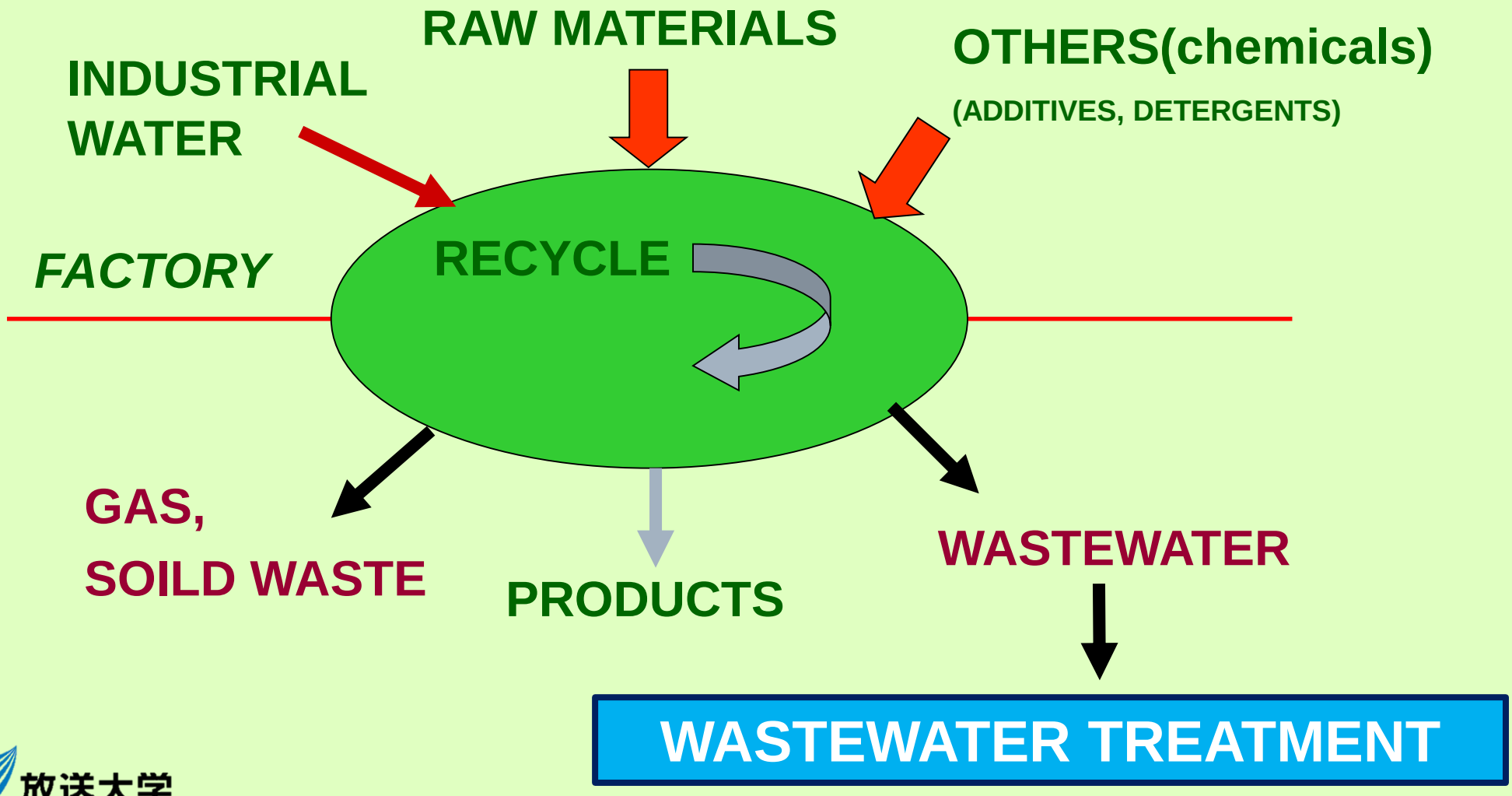
How to satisfy with the effluent quality standard?



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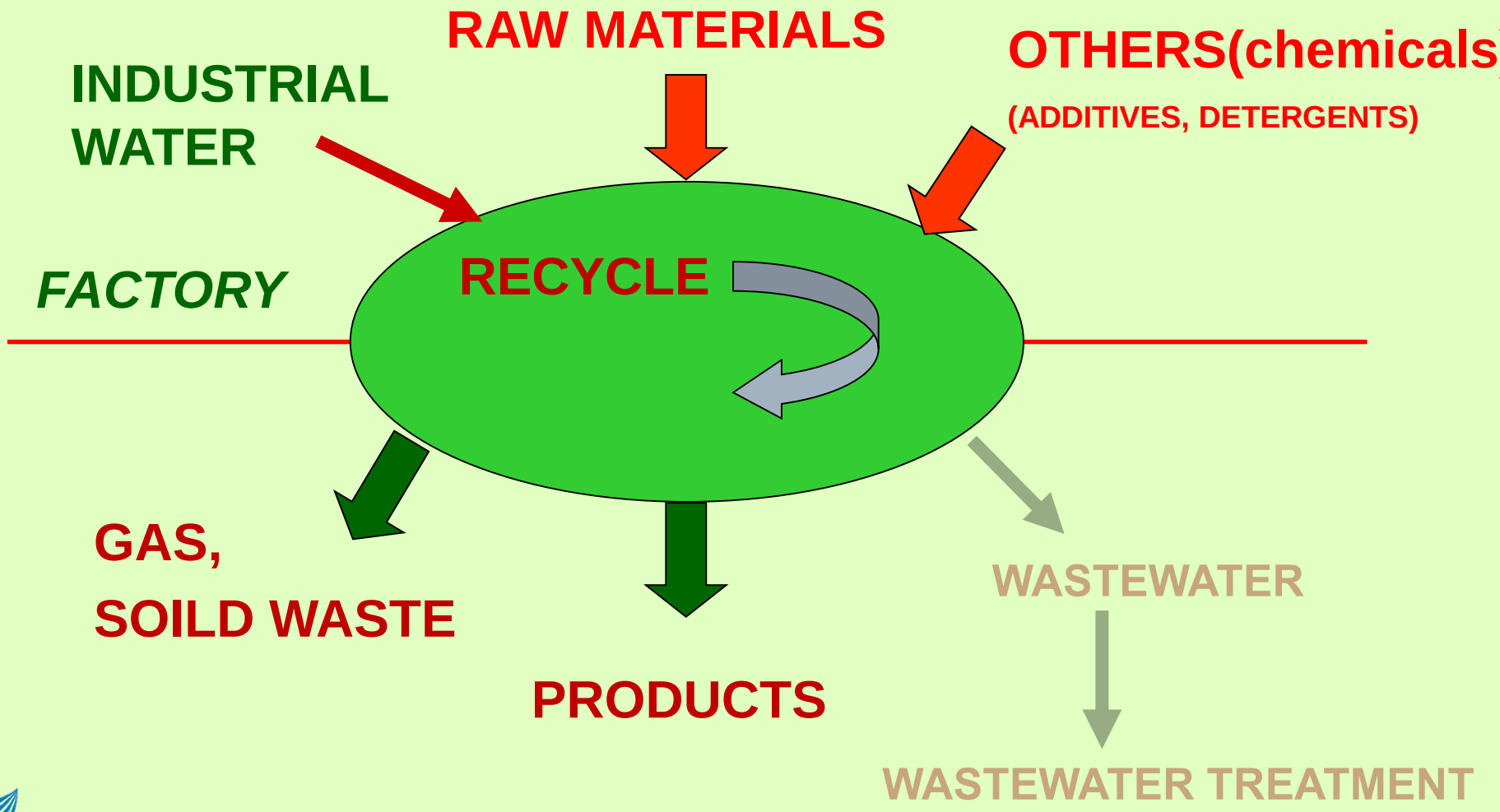

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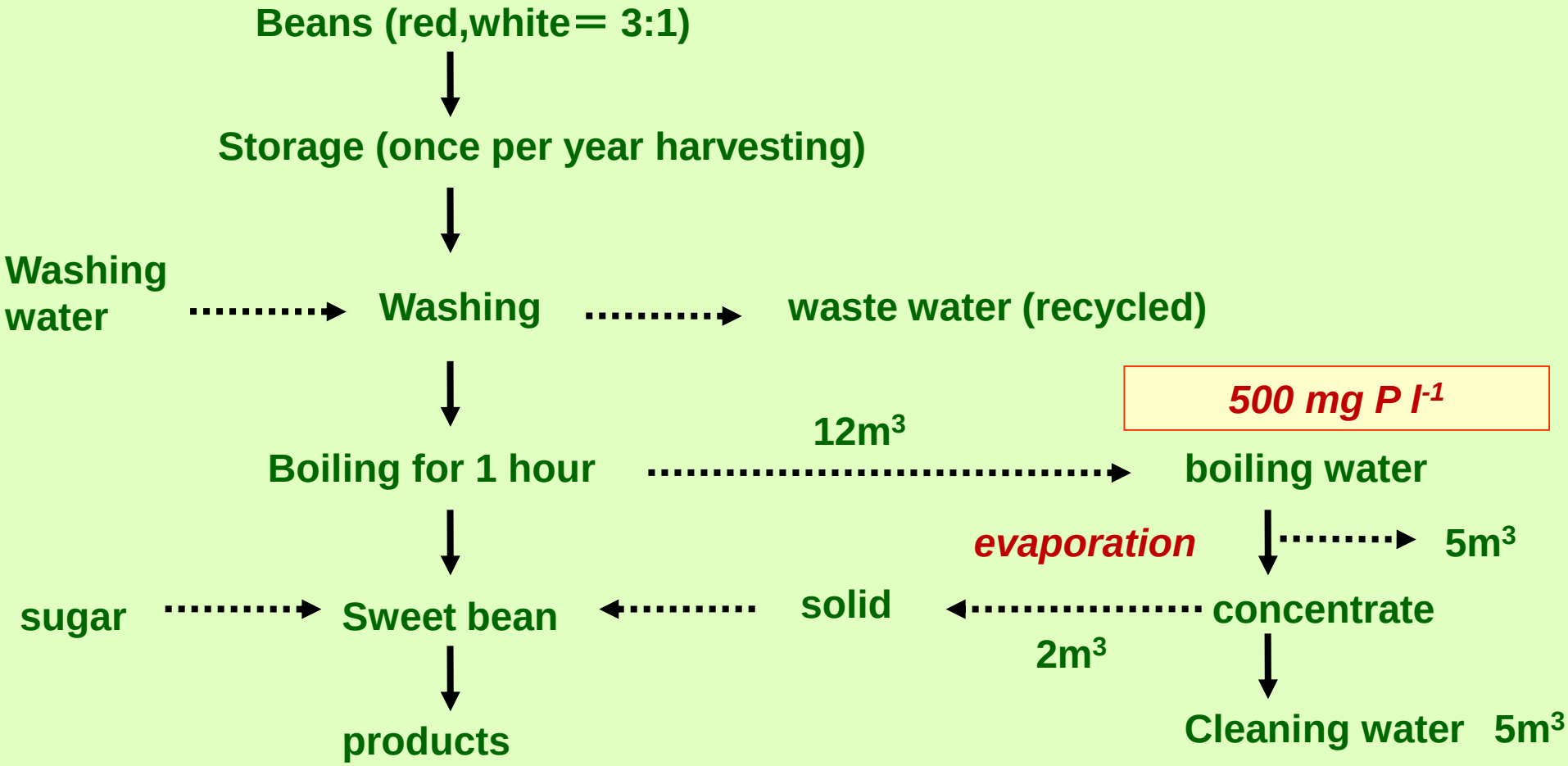
BOILING WASTEWATER RECYCLING TO REDUCE EFFLUENT T-P



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