

# Development and Diffusion of Enhanced Communal Waste Water Treatment System with Innovative Appropriate Technologies

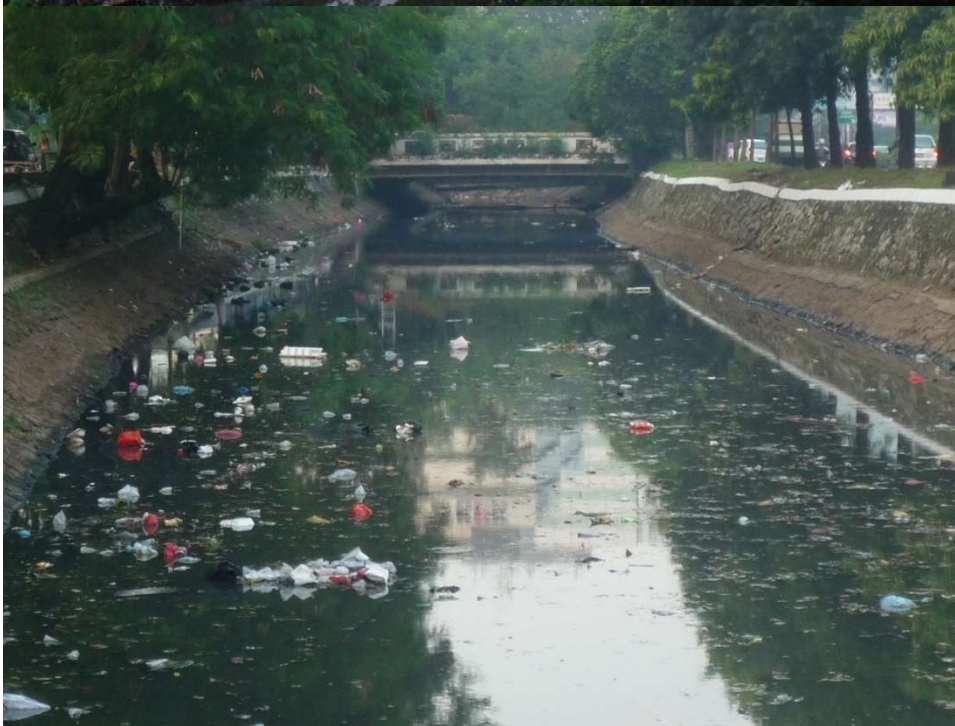
– Based on Practice in Indonesia -

12 December 2017  
Nao Tanaka Ph.D.,  
APEX





# Water Pollution in Indonesia





## Poor Sanitary Conditions in Indonesia

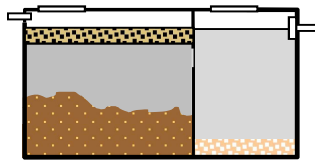




# Necessity of Appropriate Technology Development In the Case of Communal Waste Water Treatment

[ Background ]

Urbanization → bad sanitary conditions, water pollution



Too densely populated  
for individual treatment



Centralized Sewage  
System is too costly



Communal Waste Water Treatment  
as practical solution

## Conditions Required to Communal Waste Water Treatment in Indonesia

1. Low Cost (Initial Investment, Operation)

2. Easy Operation & Maintenance

3. Low Energy Consumption

4. Space Saving

5. High Treated Water Quality

# Waste Water Treatment Appropriate Technology Center (PUSTEKLIM, Yogyakarta, Indonesia)



Since 2002, jointly managed by APEX and Dian Desa Foundation

# SANIMAS

Sanitasi Berbasis Masyarakat  
(Community Based Sanitation)

2003 "Development of Community-based Water Supply and Environmental Services" was issued as national policy

2003 - 2004

Pilot Action (7 districts in 2 provinces)

2006 - 2009

Up-Scaling (80 districts/cities in 22 provinces)

2010 DAK SLBM (Special Allocated Fund for Community Based Environmental Sanitation) was launched

*Oswar Mungkasa, BAPPENAS, 2010*

## 2010 - 2014 PPSP I

PPSP (Program Percepatan Pengembangan Sanitasi Permukiman, Sanitation Development Acceleration Program)

2015 Universal Access was declared as a target by 2019

## 2015 - 2019 PPSP II

More than 500 districts/cities had involved in PPSP ( I , II ) by 2016

[www.sanitasi.or.id](http://www.sanitasi.or.id)

In spite of these efforts, still 32% (82million) people of total population were lacking basic sanitation and 12% (30million) people were conducting open defecation in 2015

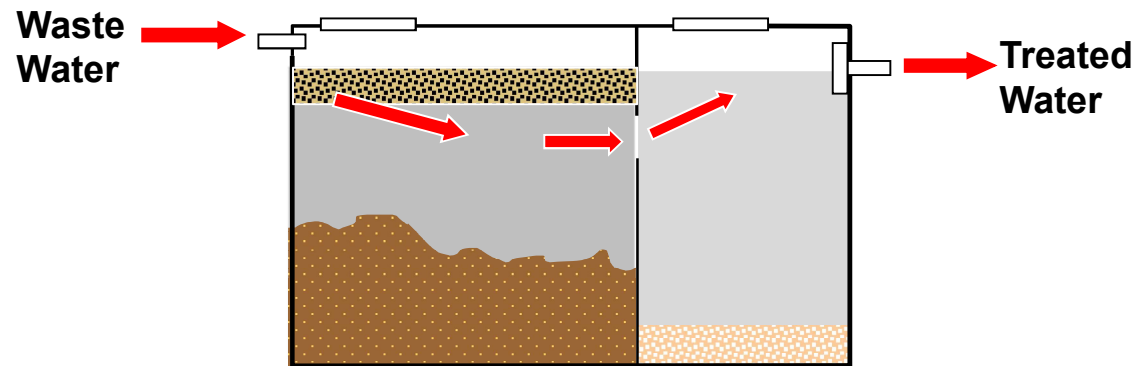
*"Progress on Drinking Water, Sanitation and Hygiene" WHO/UNICEF, 2017*



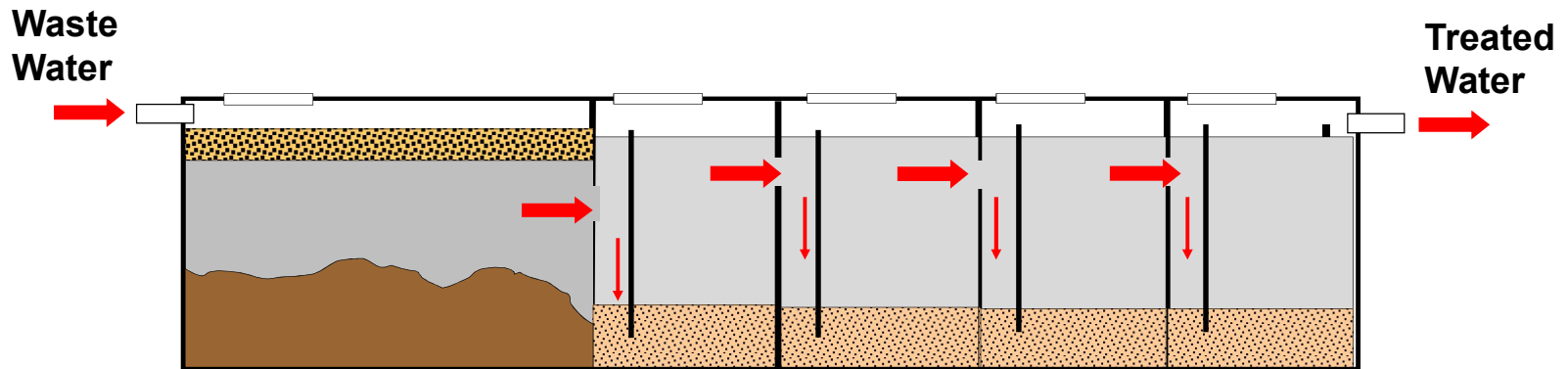
# Two Different Types of Biological Treatment

- Anaerobic and Aerobic Treatment -

## (A) Anaerobic Treatment

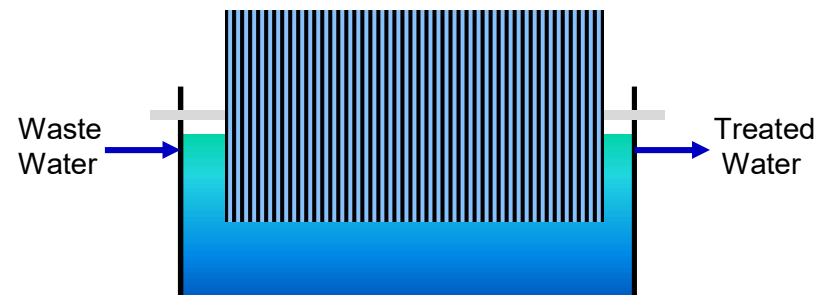
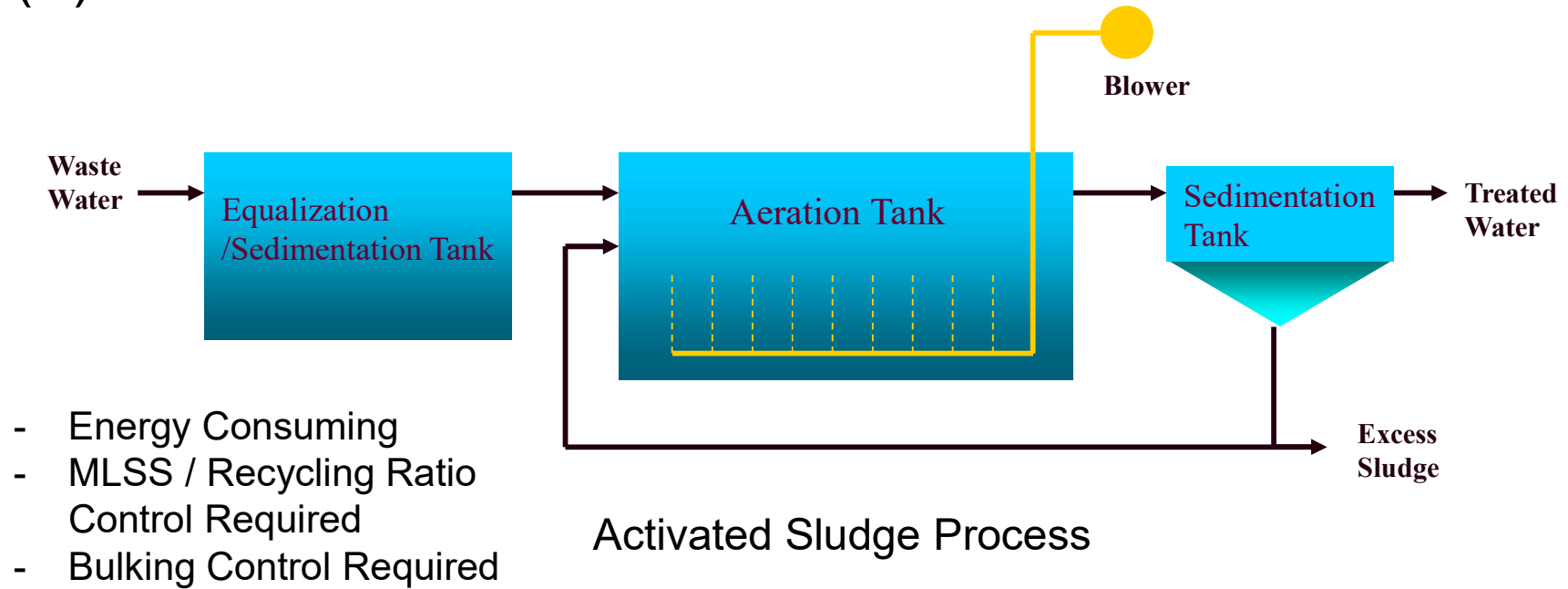


Septic Tank



Anaerobic Baffled Reactors (ABF)

## (B) Aerobic Treatment



Rotating Biological Contactors (RBC)

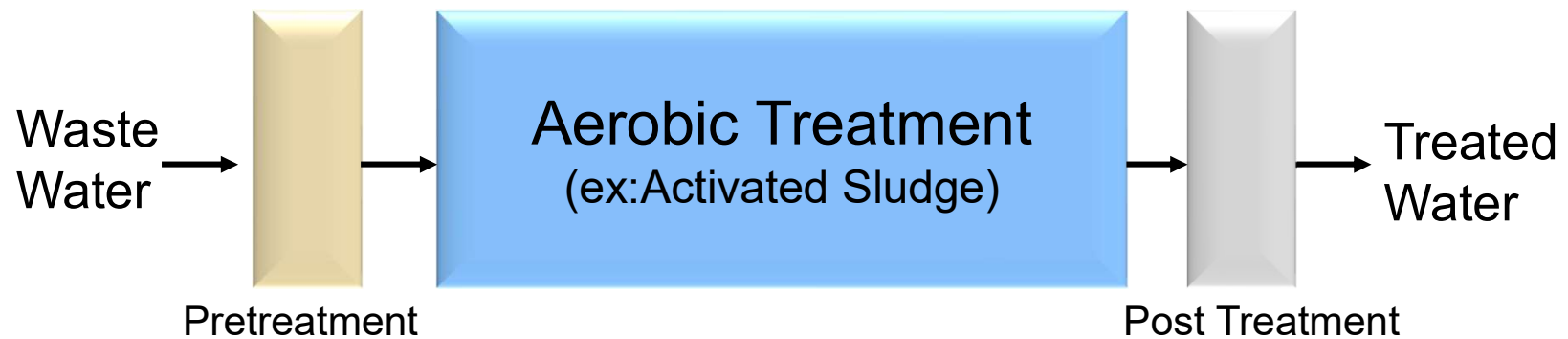


## Process Usually Used in Indonesia



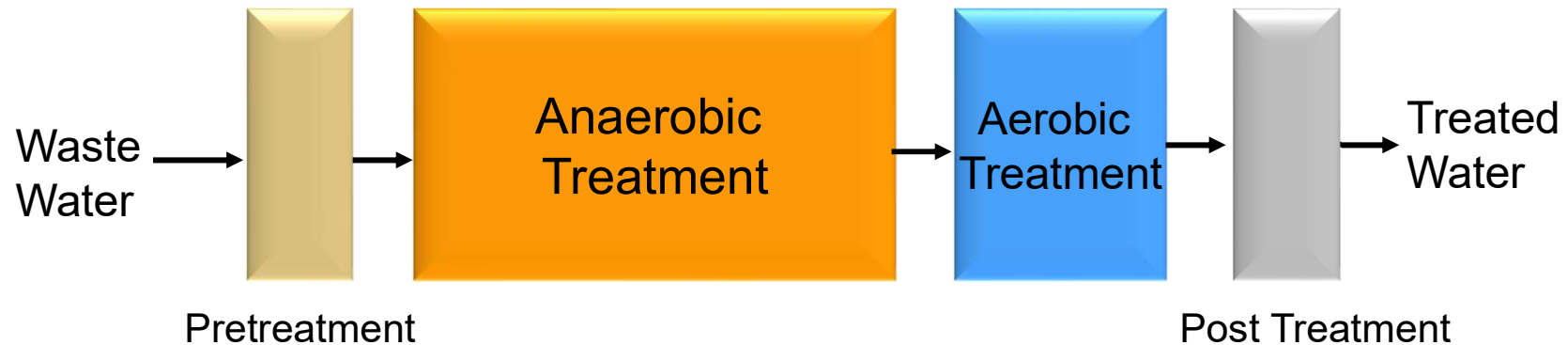
Low Electricity Consumption / Insufficient Treated Water Quality

## Process Usually Used in Japan



High Electricity Consumption / High Treated Water Quality

## Process Recommended by APEX/PUSTEKLIM

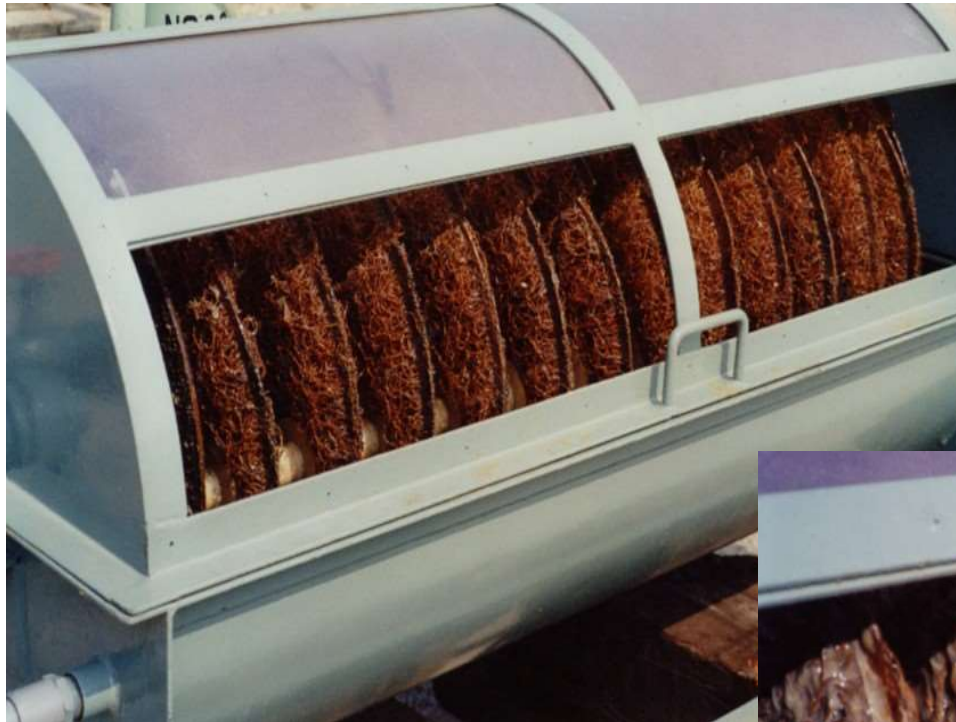


Low Energy Consumption/ High Treated Water Quality

Then, what kind of aerobic treatment process is suitable for communal waste water treatment in Indonesia ?



# RBC (Rotating Biological Contactors)



Before Operation

Operation: Keep Rotating Only  
Maintenance: Oil & Grease

As aerobic process in the combination system, RBC was selected as operation/ maintenance is easy and energy consumption is low

In Operation



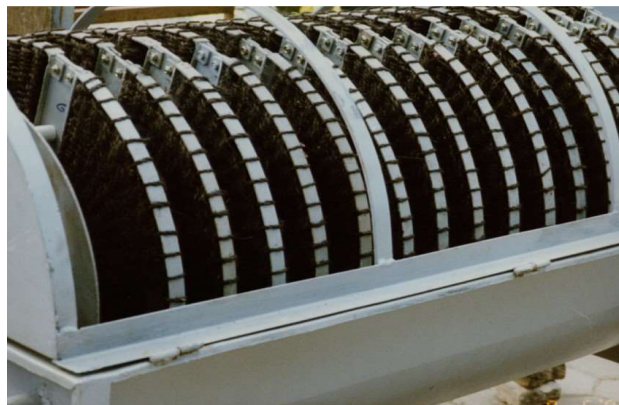
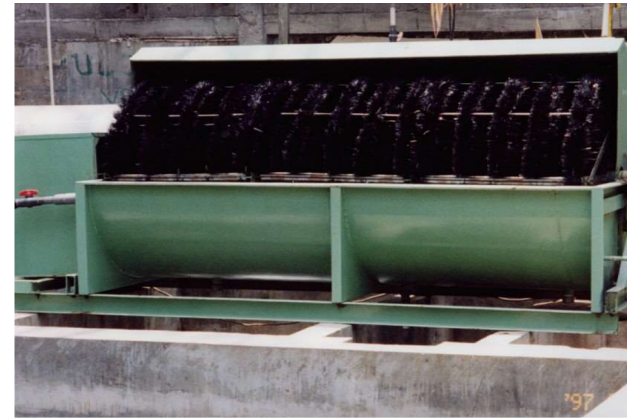
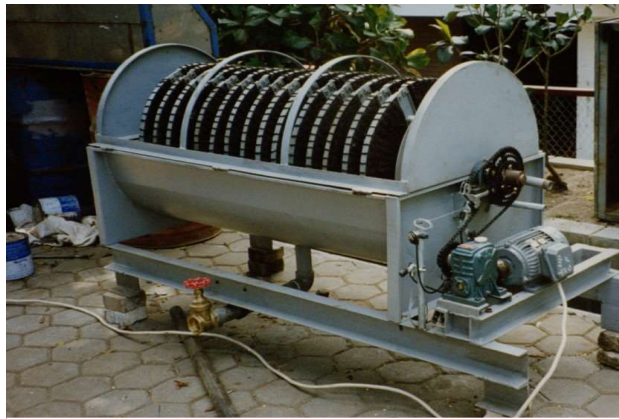
In principle, RBC is considered to fit well to Asian countries. However conventional RBCs available in developed countries are costly and difficult to be produced in Indonesia





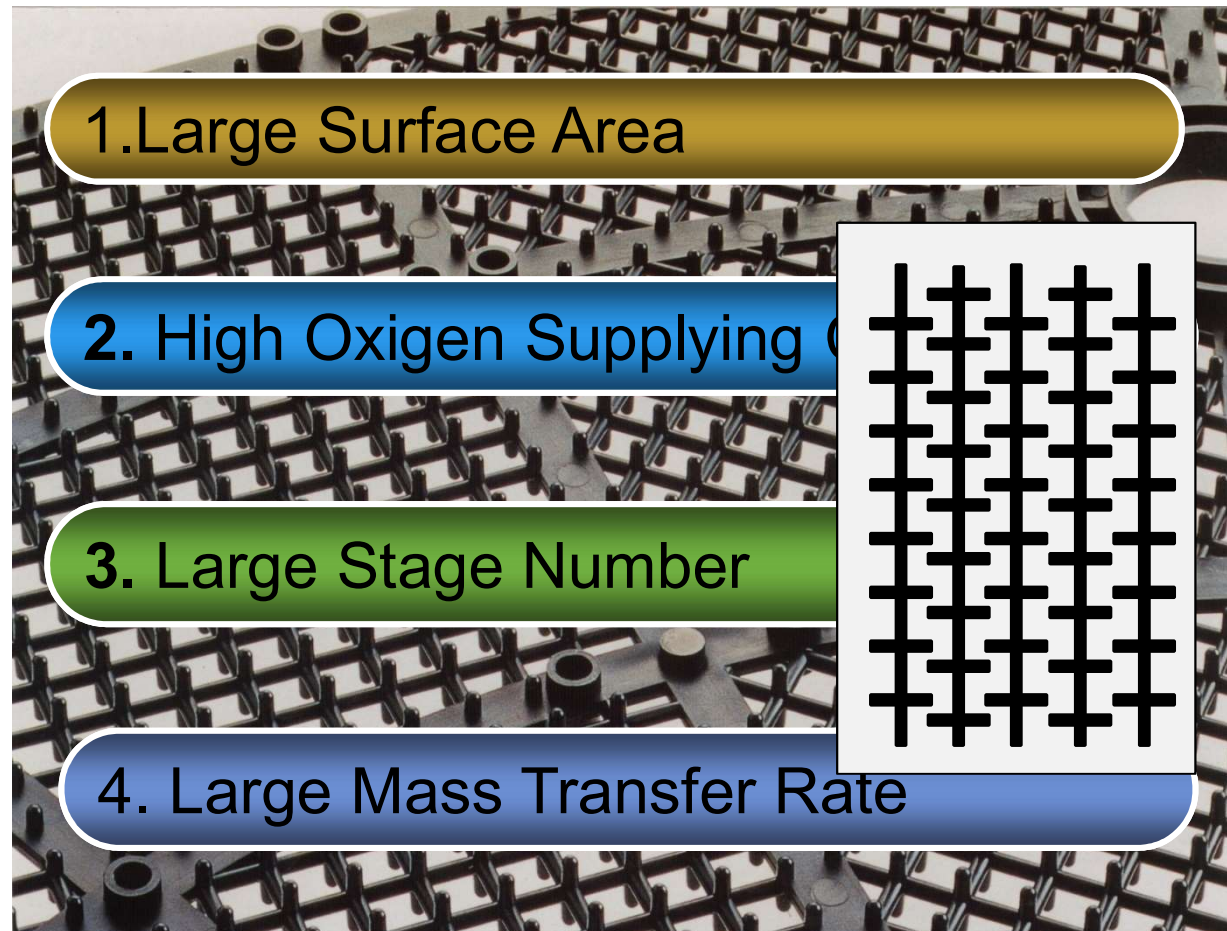
First, APEX/Dian Desa tried to develop RBC with palm fiber contactors.

→ low cost; efficiency is comparable to conventional RBC; but not so durable; if microorganism layers become thick, efficiency goes down



Then, APEX had come up with a innovative concept of new contactors, which is highly efficient, durable and easy to be produced in Indonesia, that is,

### **Three-Dimensional Lattice Contactors**



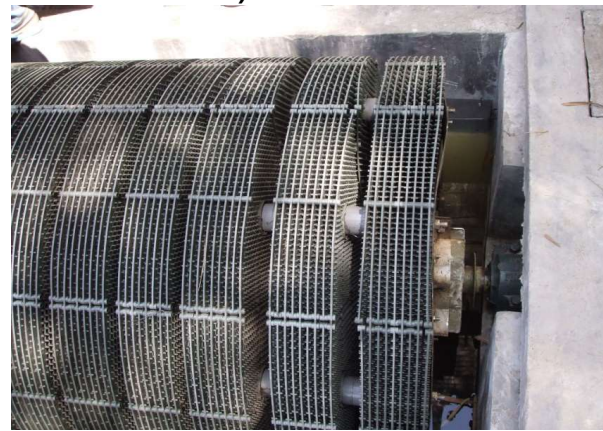


Collaborating with a Japanese Private Company and Dian Desa Foundation, RBC with Three-Dimensional Lattice Contactors was developed

Made in Japan (Sekisui Environment)

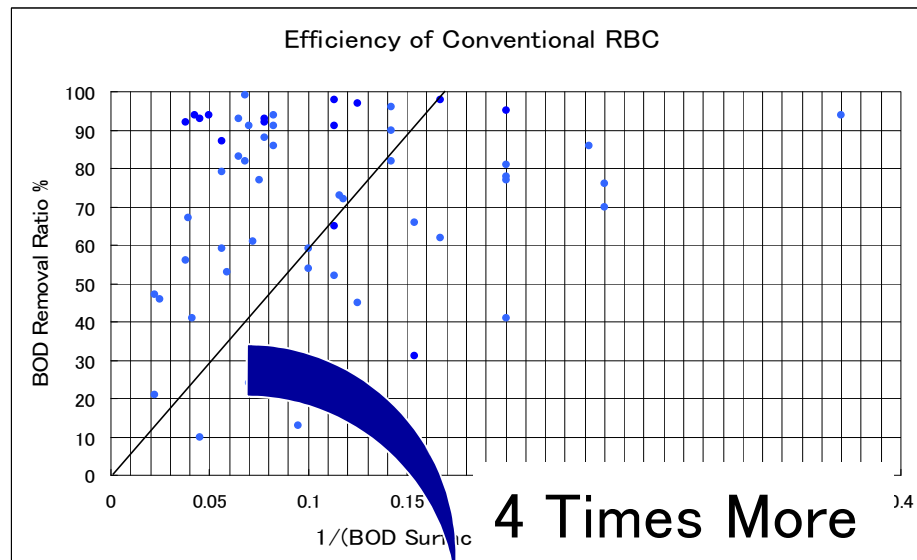


Made in Indonesia (Dian Desa Foundation)

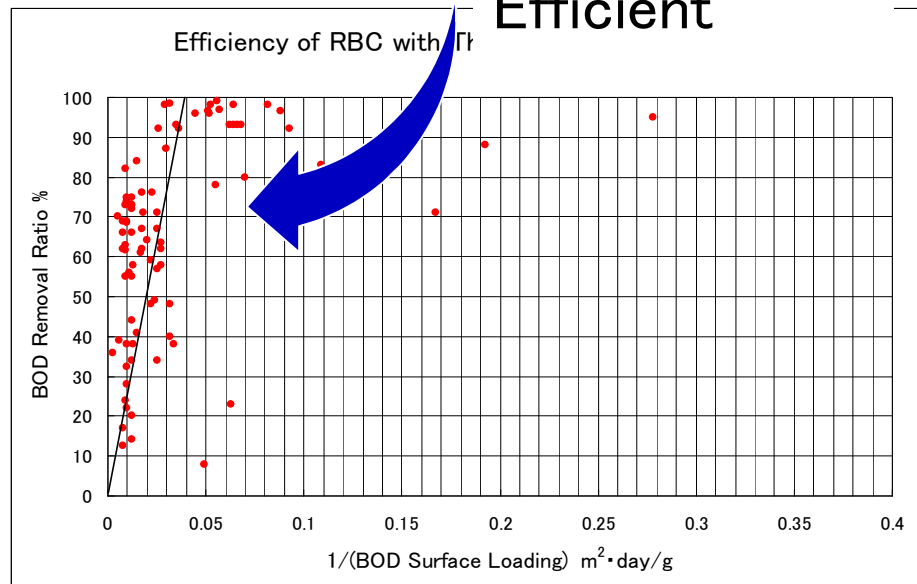




# Comparative Study as for Efficiency



4 Times More  
Efficient



Conventional RBC



Three-Dimensional Lattice RBC

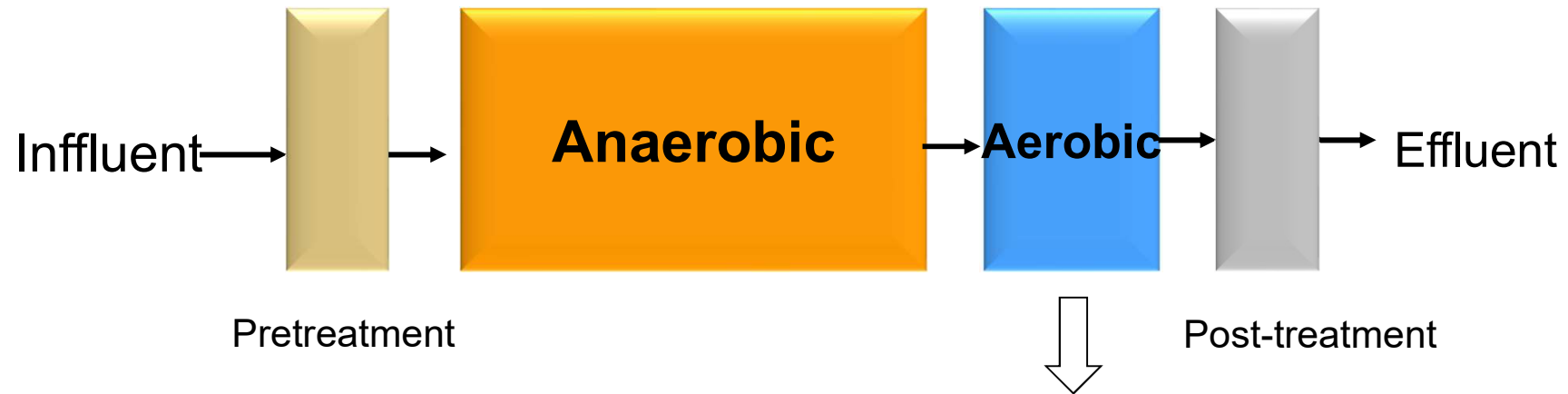


By.H.Araki (Saga Univ)

Three-Dimensional Lattice RBC  
is totally producible in Indonesia



## Process recommended by APEX/PUSTEKLIM



- High treated water quality
- Easy operation & maintenance
- Energy saving
- Space saving





# Process for Construction of Communal Plant

## (1) Discussion/Negotiation with Local Government



Tegal City



Pekalongan City



Solo City



Tabanan Regency



## (2) Visit Candidate Sites



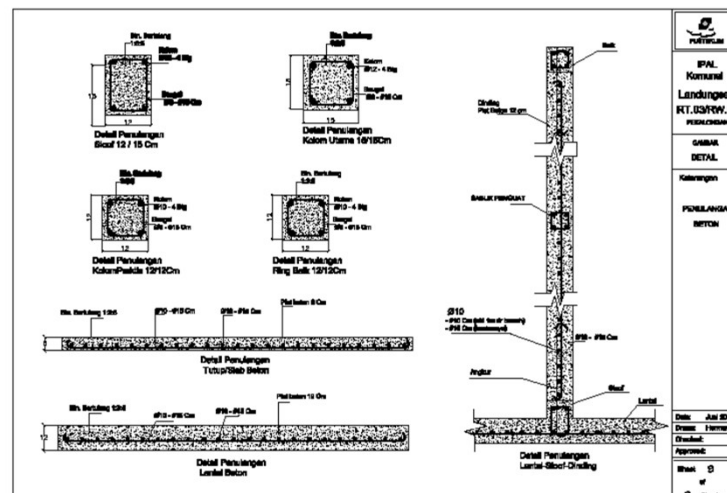
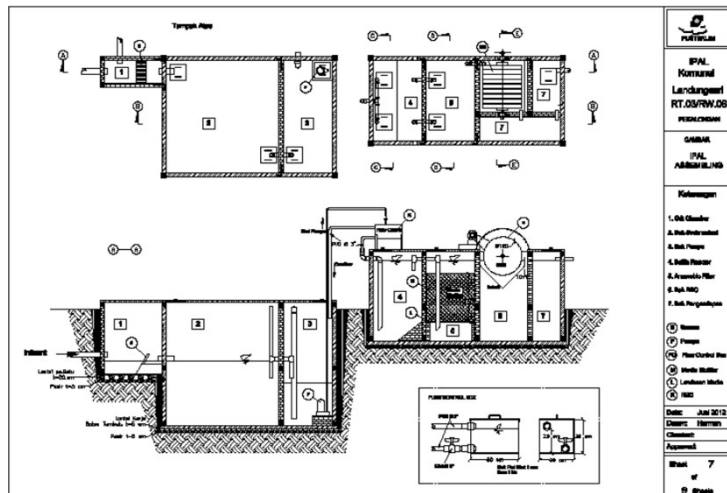
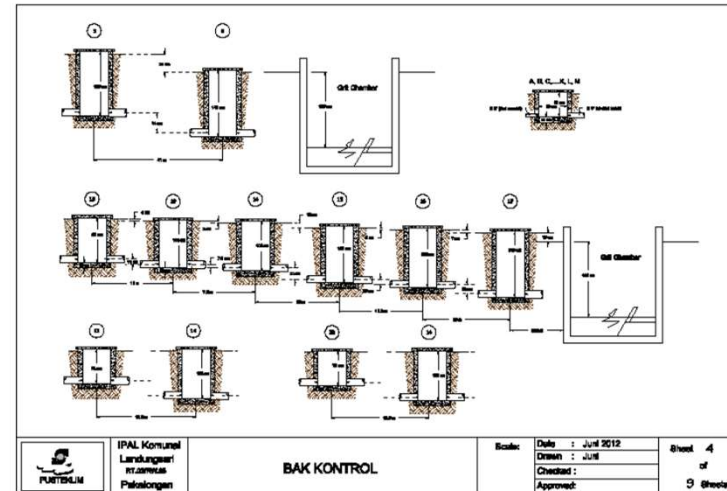


### (3) Meeting with Community People

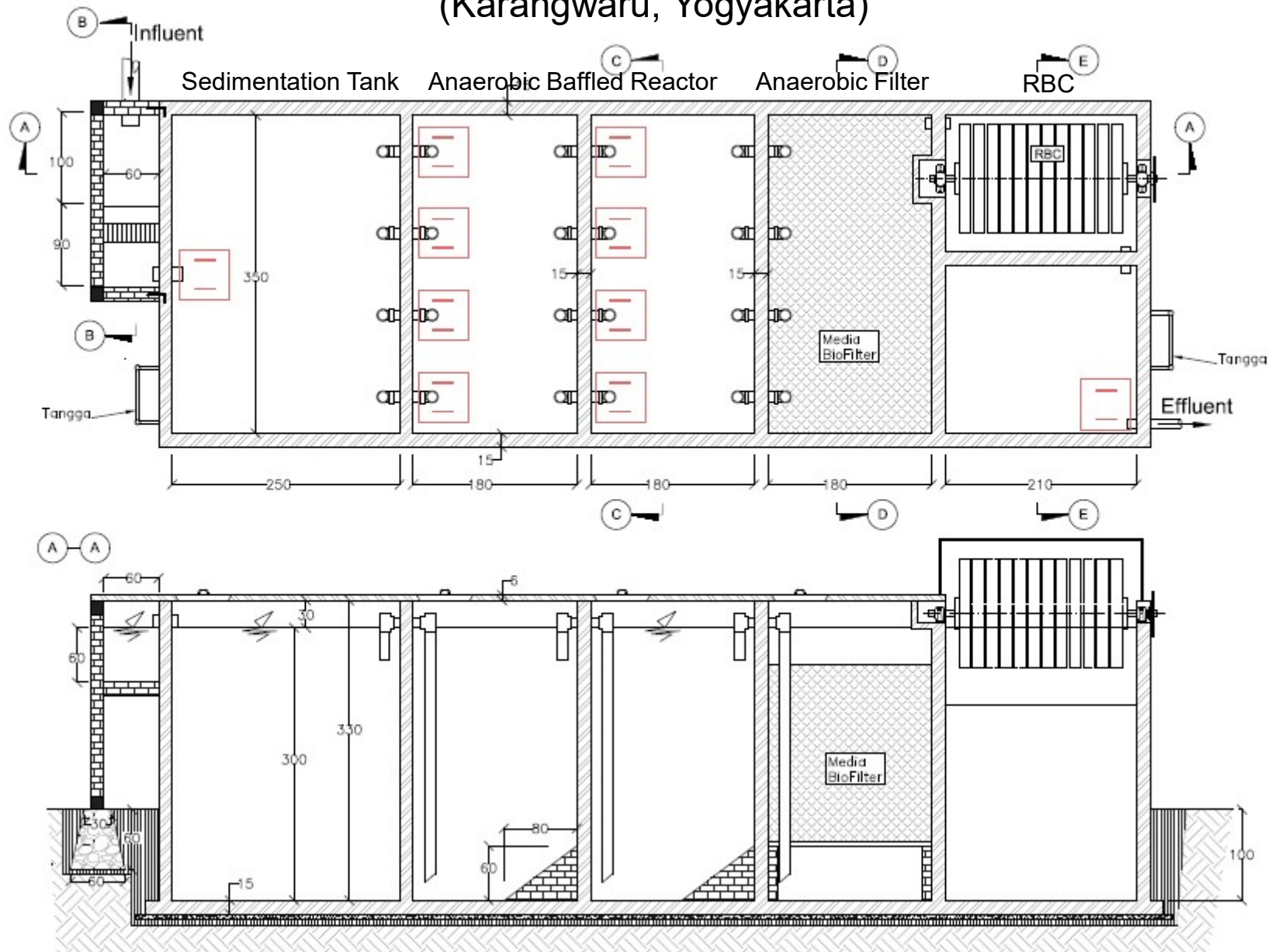




## (4) Designing



# Communal Waste Water Treatment System (Karangwaru, Yogyakarta)





## (5)Construction

- Installation of Treatment Process -





## - Construction of Piping System -





## (6) Training on Operation and Maintenance





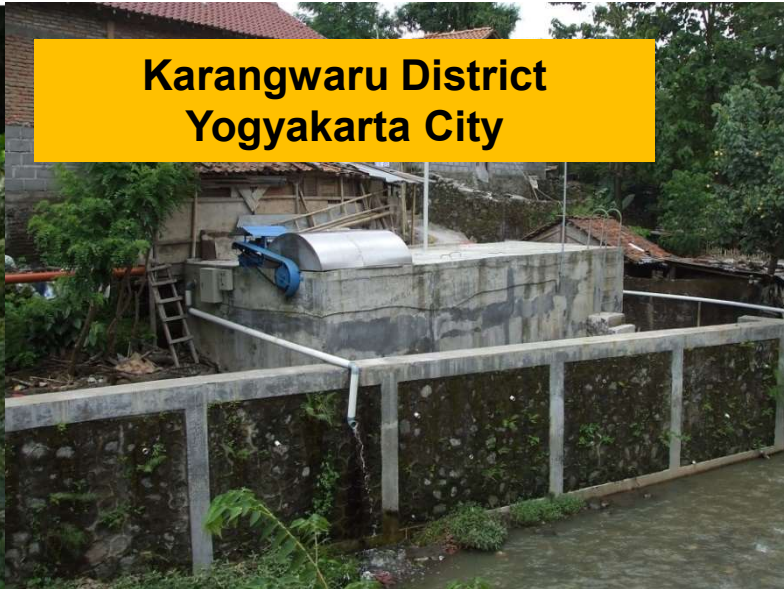
## (7) Completion of Construction



**Kricak Kidur District Yogyakarta City**

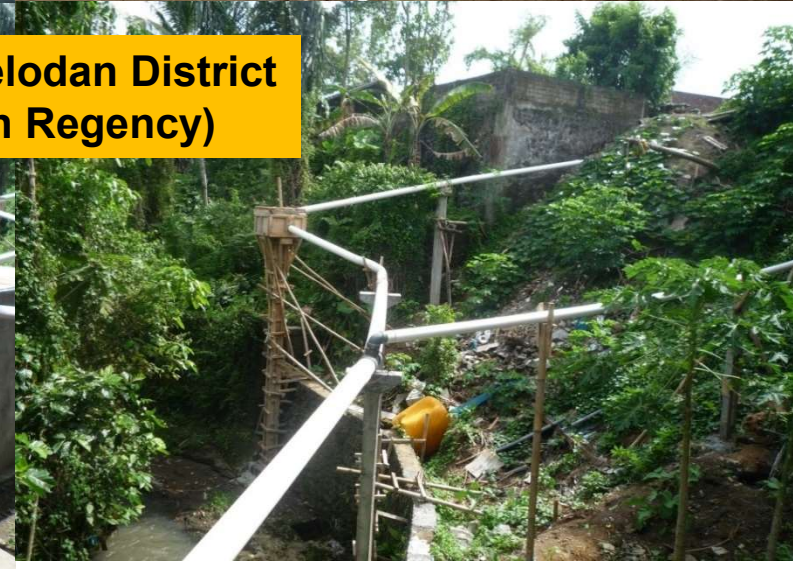
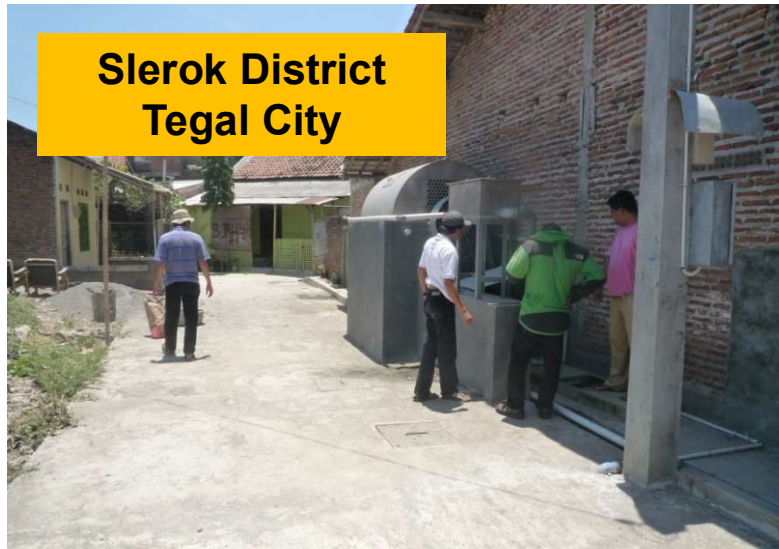


**Kricak Lor District  
Yogyakarta City**

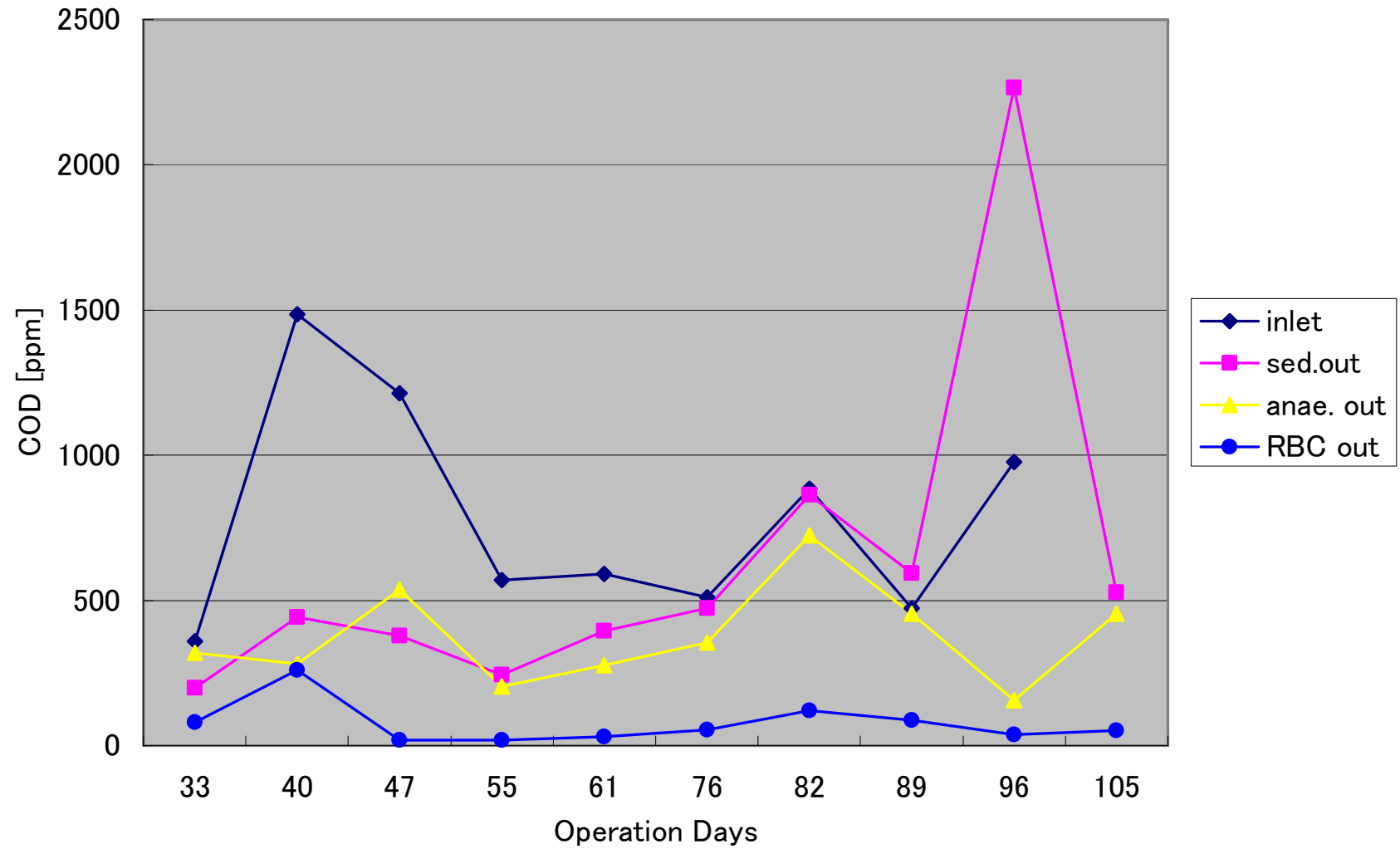


**Karangwaru District  
Yogyakarta City**





# Trend of COD (Kricak Kidul, Yogyakarta)



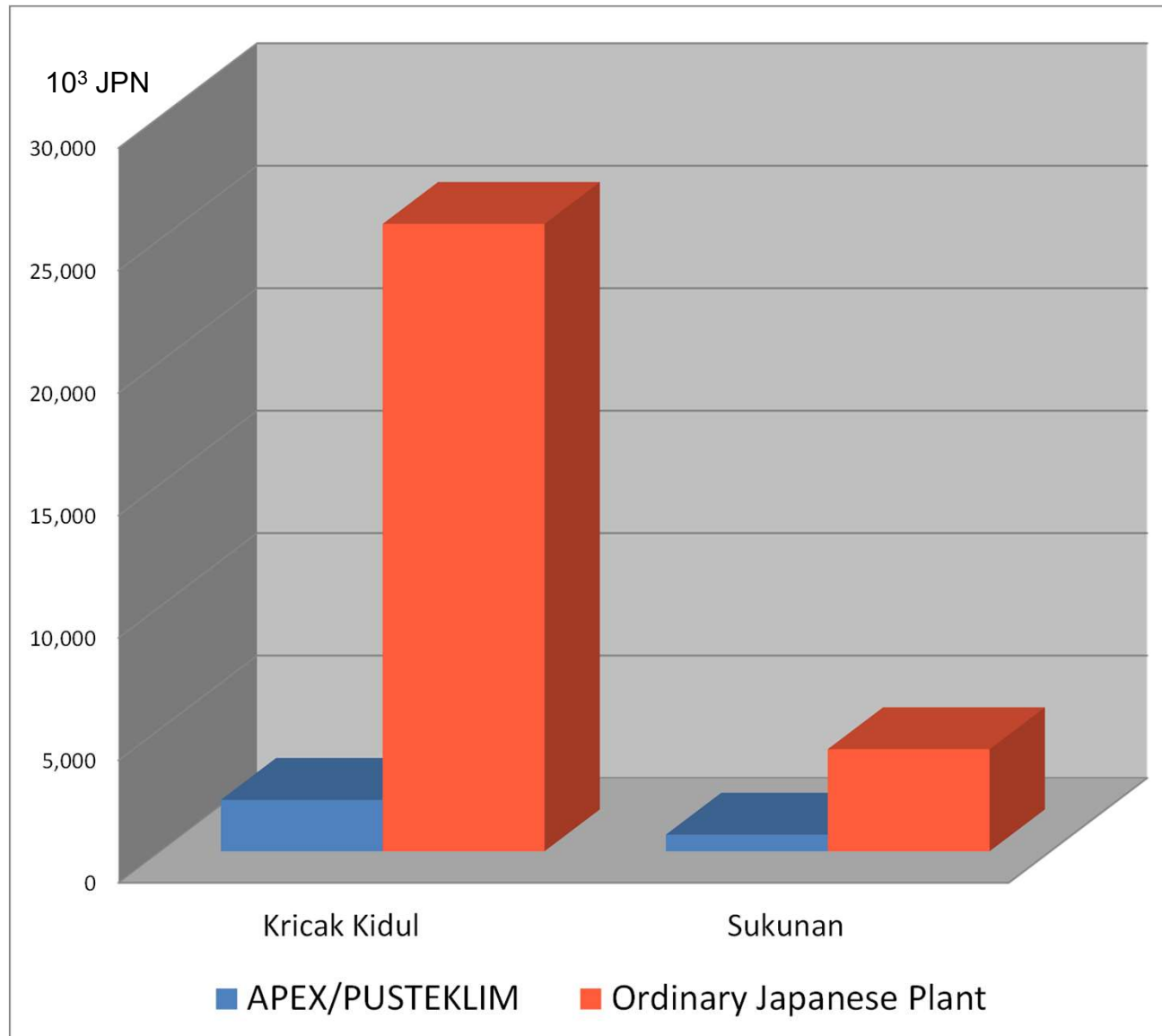
# Domestic Waste Water Quality Standard

Parameter	Unit	Permen-LH-2014	Permen-LHK-2016
pH	–	6–9	6–9
BOD	mg/L	100	30
COD	mg/L	–	100
TSS	mg/L	100	30
Oil & Fat	mg/L	10	5
Ammonium	mg/L	–	10
Total Coliform	counts/100mL	–	3.000
Flow Rate	L/capita/day	–	100

Permen:Minister's Regulation, LH: Environment, LHK: Environment and Forestry



## Comparison of Construction Costs



## Existing Model System in Indonesia

City/Regency	Community	Connected Houses	Start	Memo
Yogyakarta	Kricak Kidul	65	May 2008	
	Karangwaru	81	Feb.2013	
	Kricak Lor	50	Feb.2013	
Sleman	Sukunan	145	Jun 2008	5 unit
	Tulung	63	Jan 2016	
	Pondok	97	Okt 2017	Renovation
Tegal	Slerok (RT2, RW12)	40	Sep.2013	
	Slerok (RT2,3, RW4)	40	Sep.2015	
Pekalongan	Landungsari	36	Des.2012	
	Sapuro	38	Des.2014	
Tabanan	Pasekan Belodan	45	Peb.2013	

- Model systems have been operated and maintained by community people by themselves with their own expenses. Oldest ones have been operated more than 9 years.
- Construction cost of the system with capacity of 70 – 80 households is around 26,000 – 30,000 USD including piping. The cost is slightly less than conventional system of anaerobic treatment.
- Operation cost of the system is around 30 – 45 USD per month including electricity, wages for the operator and oil/grease, which is covered by community people's contribution 0.45-1.32 USD per family per month.
- Usually, the desludging work is conducted by the operator by using underwater pumps. In some communities sludge generated from the system is dehydrated by sand dry bed and recycled as compost.



# Authorized by Indonesian Central Government (Sep 2017)

**KEMENTERIAN PEKERJAAN UMUM DAN PERUMAHAN RAKYAT**  
**DIREKTORAT JENDERAL CIPTA KARYA**  
**SATUAN KERJA PENYEHATAN LINGKUNGAN PERMUKIMAN BERBASIS MASYARAKAT**  
Jalan PAM Baru I No.1 Pejompongan, Jakarta - Pusat 10210 Telp. (021) 57905889

Nomor : UM 02.06/PLPBM/880/1x/2017 Jakarta, 19 September 2017  
Lampiran : -  
Hal : Opsi Teknologi IPAL Komunal

Kepada Yth  
Instansi Pemerintah terkait Pembangunan IPAL Komunal  
Tingkat Propinsi/Kota/Kabupaten seluruh Indonesia


Dengan hormat,

Dengan ini, kami menyatakan bahwa IPAL Komunal dengan sistem PUSTEKLIM (Pusat Pengembangan Teknologi Tepat Guna Pengolahan Limbah Cair, Jl. Kaliurang km 07, Yogyakarta) yang terdiri dari proses kombinasi anaerobik dan aerobik, menggunakan RBC Lattice Tiga Dimensi sebagai proses aerobik adalah salah satu opsi teknologi IPAL Komunal yang berkualitas. Berdasarkan penelitian dari Pusat Penelitian dan Pengembangan Permukiman Kementerian PUPR, sistem tersebut terutama sesuai dengan kasus lahan terbatas dan/atau dibutuhkan kualitas effluen (air olahan) yang tinggi.

Dengan pertimbangan - pertimbangan di atas, kami mengapresiasi IPAL Komunal sistem PUSTEKLIM tersebut untuk diimplementasikan pada proyek IPAL Komunal di kota/kabupaten yang menerima DAK SLBM maupun anggaran dari sumber dana lainnya.

Demikian disampaikan, atas perhatiannya diucapkan terimakasih.

Referensi: Notulen Rapat Puslitbang Permukiman Kementerian PUPR dan PUSTEKLIM.

  
**Satgas DAK Sanitasi**  
**Kementerian PUPR**  
**Ir. Komang Raka Maharathana, M.AP.**  
NIP. 196510191996031001

Tembusan disampaikan Kepada Yth.:

1. Direktur Pengembangan Penyehatan Lingkungan Permukiman, DJCK (sebagai laporan)
2. Kasubdit Pengolahan Air Limbah, Direktorat PPLP, DJCK
3. Pertiagal



Other than Indonesia & Japan, RBC with  
Three-Dimensional Lattice Contactors is  
now being diffused in China



Photo:Sekisui Aqua System Co.,Ltd.

## Summary

- In Indonesia, decentralized domestic waste water treatment system is expected to take a significant role for improving urban sanitary conditions. However in most cases, only anaerobic treatment is conducted, resulting insufficient treated water quality.
- In this context, APEX (Japanese NGO) in collaboration with Dian Desa Foundation (Indonesian NGO) and Japanese private company has developed a combination system of anaerobic and aerobic process in which originally developed Rotating Biological Contactors with three dimensional lattice contactors is used as aerobic process.



- The developed system is characterized by its low cost, easy operation & maintenance, energy saving, space saving and high treated water quality.
- The system is totally producible in ordinary workshop in Indonesia and operation & maintenance can be managed by community people by themselves in self-sufficient and sustainable way.
- Other than Indonesia, the system is now rapidly diffused in China.