Technology Implementation of P recycling in Japan

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*PRPCJ: Phosphorus Recycling Promotion Council of Japan

Key issue

Technologies are available for P recycling.

However, they are not well implemented.

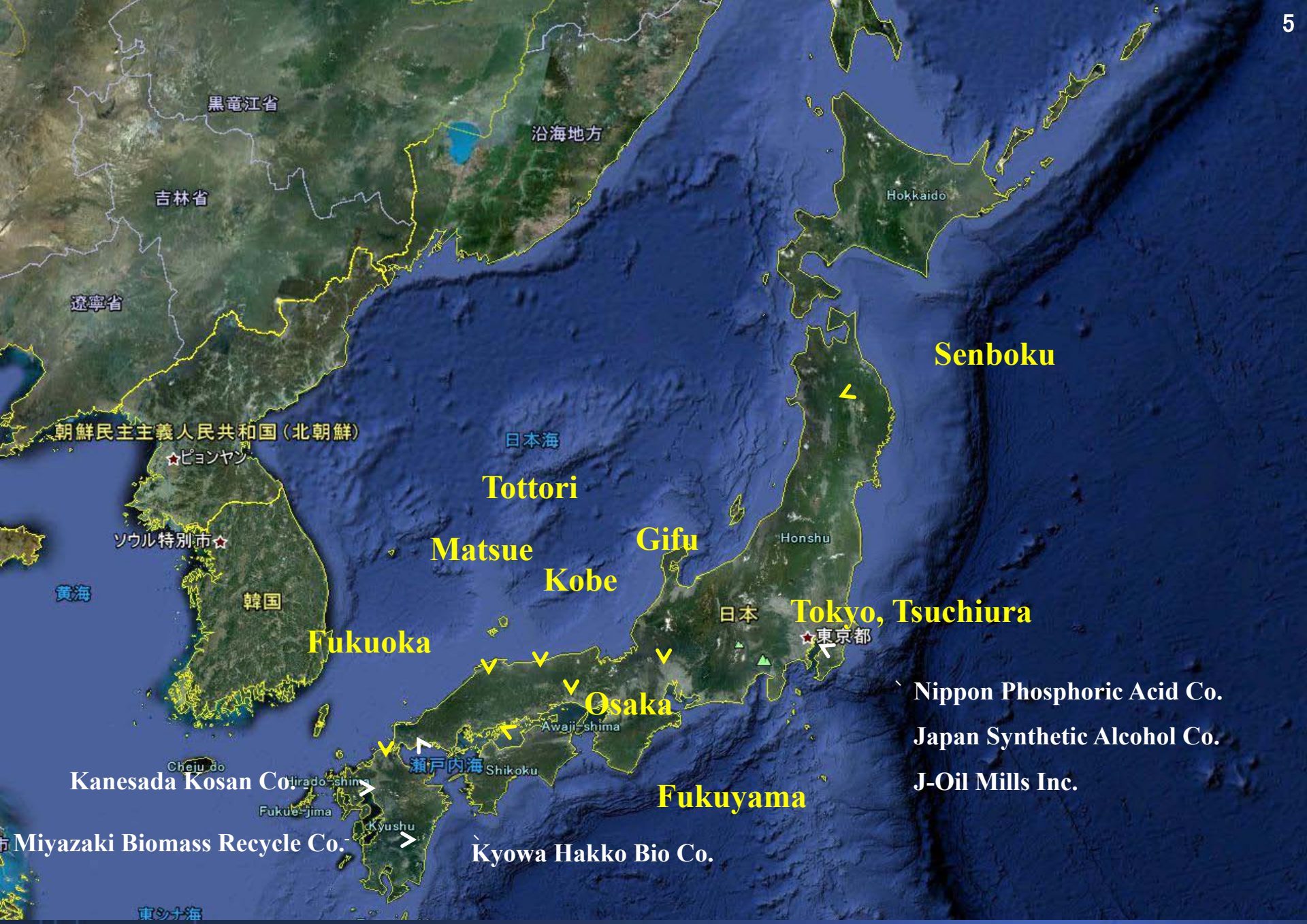
Why Japan?

Japan has a lot of experience

and good practice in P recycling.

P recycling in Japan

- Gifu and Tottori WWTPs (Sludge incineration ash)
- Fukuoka and Matsue WWTPs (Sludge digestion liquor)
- Senboku Sludge Treatment plant (Human waste)
- Nippon Phosphoric Acid Co. (Sludge incineration ash)
- Japan Synthetic Alcohol Co. (Spent chemical catalyst)
- Kyowa Hakko Bio. Co. (Fermentation waste)
- J-Oil Mills Incorporation (Food waste)
- Miyazaki Biomass Recycle Co. (Poultry manure)
- Kanesada Kosan Co. (Used extinguishing agent)

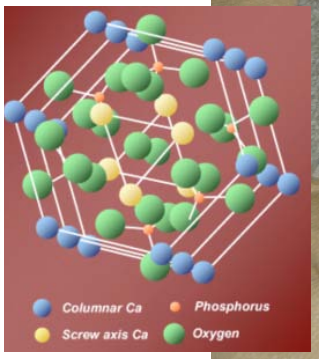

黒竜江省
沿海地方
吉林省
遼寧省
Hokkaido
Senboku
朝鮮民主主義人民共和国（北朝鮮）
ピョンヤン
日本海
Tottori
ソウル特別市
Matsue
Gifu
Honshu
Kobe
黄海
韓国
日本
Tokyo, Tsuchiura
東京都
Fukuoka
Osaka
Awaji-shima
瀬戸内海
Shikoku
Cheju-do
Kanesada Kosan Co.
Hirado-shima
Fukue-jima
Kyushu
Fukuyama
Miyazaki Biomass Recycle Co.
Kyowa Hakko Bio Co.
東シナ海
Nippon Phosphoric Acid Co.
Japan Synthetic Alcohol Co.
J-Oil Mills Inc.

The full-scale plant for recovering P from sludge incineration ash.
It started running in April, 2010, at Gifu, Japan.

From Mr. K. Goto, Gifu City Office

P fertilizer supply: 500 ton/year

HAP



From Mr. K. Goto, Gifu City Office

The full-scale plant for recovering P from sludge incineration ash.
It started running in April, 2013, at Tottori, Japan.

Struvite recovery

100-140 t MAP/year

The full-scale plant started running in 1997 at Fukuoka.

Struvite recovery

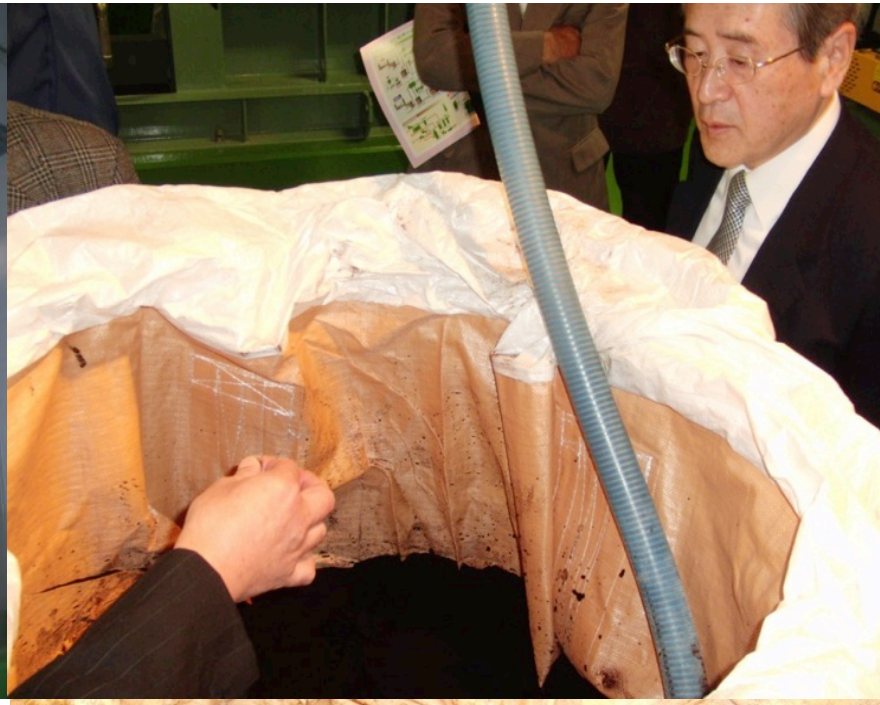
UNITIKA
We Realize It!

UNITIKA LTD.

100-150 t MAP/year

The full-scale plant started running in 1998 at Matsue.

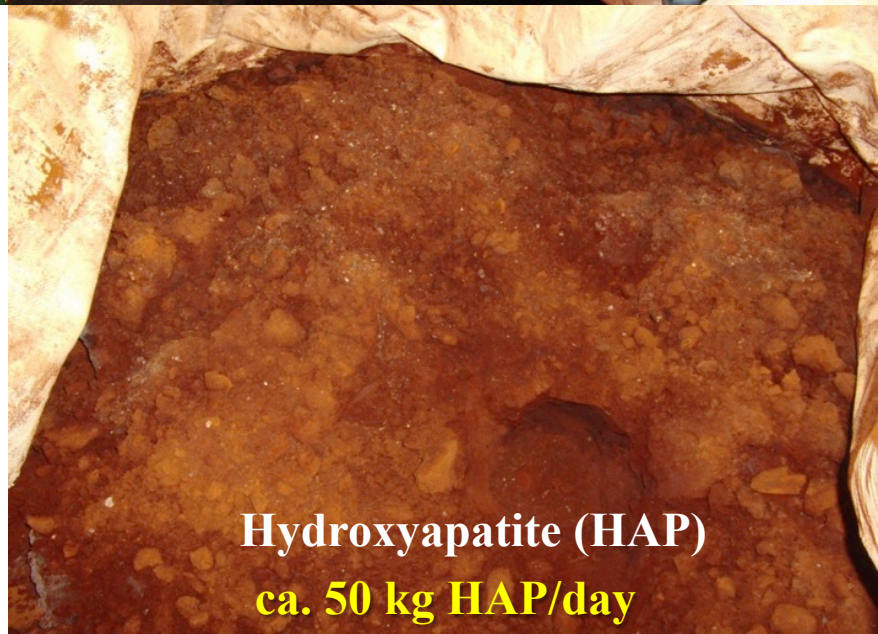
P recovery from humane waste



Crystallizer of HAP process

Capacity 60 m^3/d (equivalent to 60,000 people)

Daiki Ataka
Engineering Co.,Ltd.



Financing

Plant construction cost

50% government subsidy

50% municipal bond

Phosphoric acid from sludge incineration ash

日本燐酸株式会社
NIPPON PHOSPHORIC ACID CO.,JP

Nippon Phosphoric Acid Co. supplies phosphoric acid (280 ton/day).

Phosphoric acid from sludge incineration ash

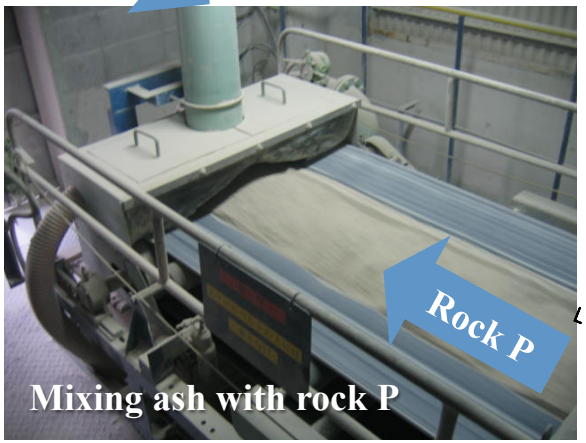
Ash

Storage

Ash

Ash

A maximum of 5% (w/w)



Mixing ash with rock P

Mixture

Sulfuric acid

Reactor

Phosphoric acid & gypsum

Filter

Phosphoric acid

Motivation and Incentive

Diversify P sources

Reduce raw material costs

Direct hydration of ethylene to ethanol

Catalyst: phosphoric acid
300°C 60 atm. *JAPAN SYNTHETIC ALCOHOL CO.,Ltd.*

J.S.A 日本合成アルコール株式会社

P recovery in the fermentation industry

P_2O_5 = 29%

CaO = 59%

Organic matter = 12%

Recovered P is sold as by-product P fertilizer.

KYOWA HAKKO BIO CO., LTD.

P recovery in the food industry

http://minarai39.blog112.fc2.com/blog-date-201108.html

J-OIL MILLS

Motivation and incentive

Meet stringent effluent standards

Reduce waste disposal costs*

***Mutual benefits with fertilizer companies**

Policy support and market

No active policy support

No established market

Japan's approaches

Take action without delay

Try everything possible

Bring benefits to Industry

Japan's strengths

- Tight regulation of waste disposal*
- Collaboration among industry, academia, and government (PRPCJ)
- Big companies' participation (CSR)
- Many SMEs in the fertilizer industry**
- Government subsidies for technology innovation

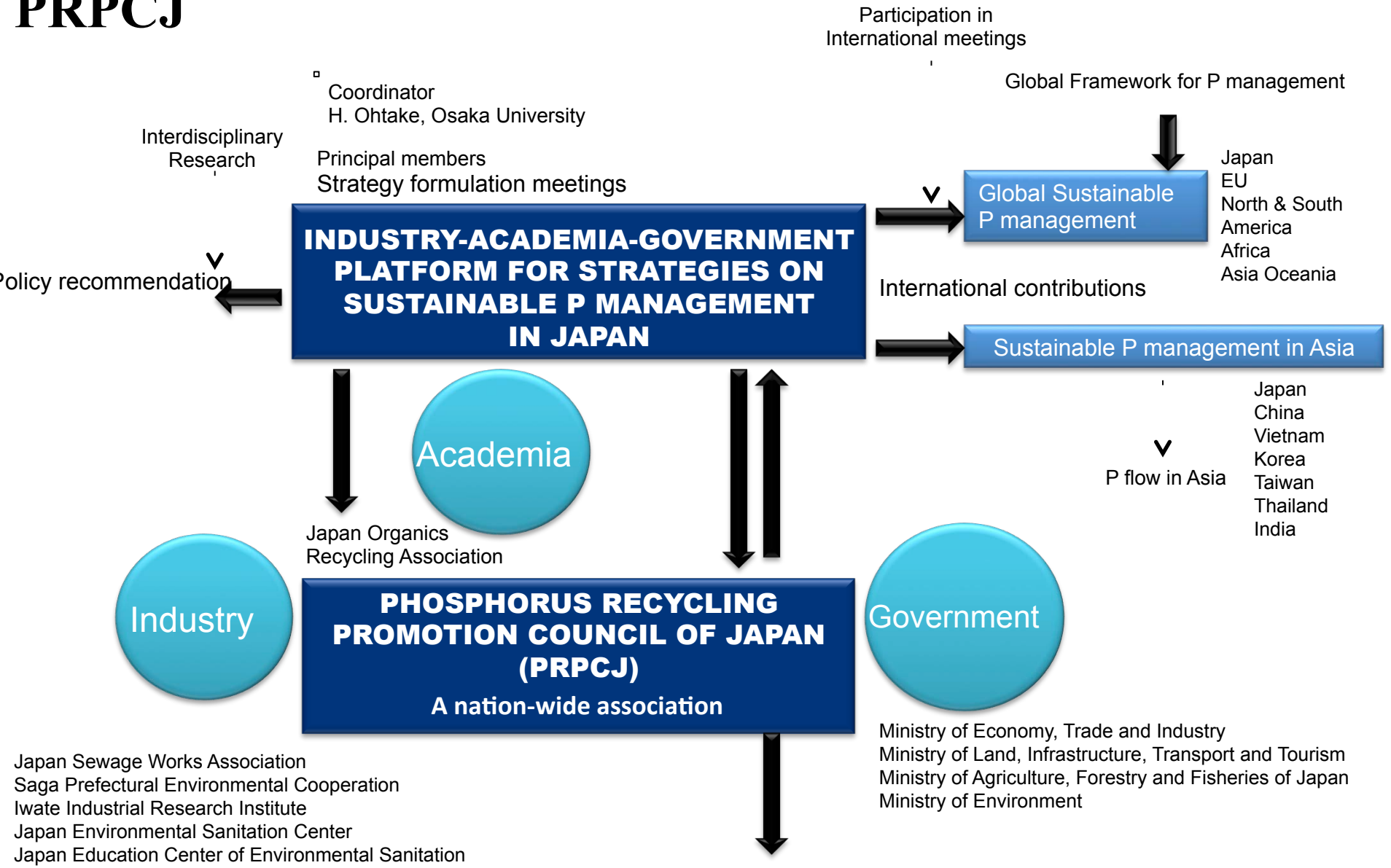
* Land filling and land application of biosolids are prohibited.

**Principal end users of recovered P.

The Phosphorus Recycling Promotion Council of Japan

150 members, 2013

PRPCJ


Participation in
International meetings
Global Framework for P management
Coordinator
H. Ohtake, Osaka University
Interdisciplinary
Research
Principal members
Strategy formulation meetings
Global Sustainable
P management
Japan
EU
North & South
America
Africa
Asia Oceania
Policy recommendation
INDUSTRY-ACADEMIA-GOVERNMENT
PLATFORM FOR STRATEGIES ON
SUSTAINABLE P MANAGEMENT
IN JAPAN
International contributions
Sustainable P management in Asia
Japan
China
Vietnam
Korea
Taiwan
Thailand
India
P flow in Asia
Academia
Japan Organics
Recycling Association
Industry
PHOSPHORUS RECYCLING
PROMOTION COUNCIL OF JAPAN
(PRPCJ)
A nation-wide association
Government
Ministry of Economy, Trade and Industry
Ministry of Land, Infrastructure, Transport and Tourism
Ministry of Agriculture, Forestry and Fisheries of Japan
Ministry of Environment
Japan Sewage Works Association
Saga Prefectural Environmental Cooperation
Iwate Industrial Research Institute
Japan Environmental Sanitation Center
Japan Education Center of Environmental Sanitation
Japan Sewage Treatment Plant construction Association
Japan Soil Association
Japan Fertilizer and Ammonia Producers Association
Japan Fertilizer and Feed Inspection Association
Japan Organics Recycling Association
More than 60 private companies
Development of P recycling systems

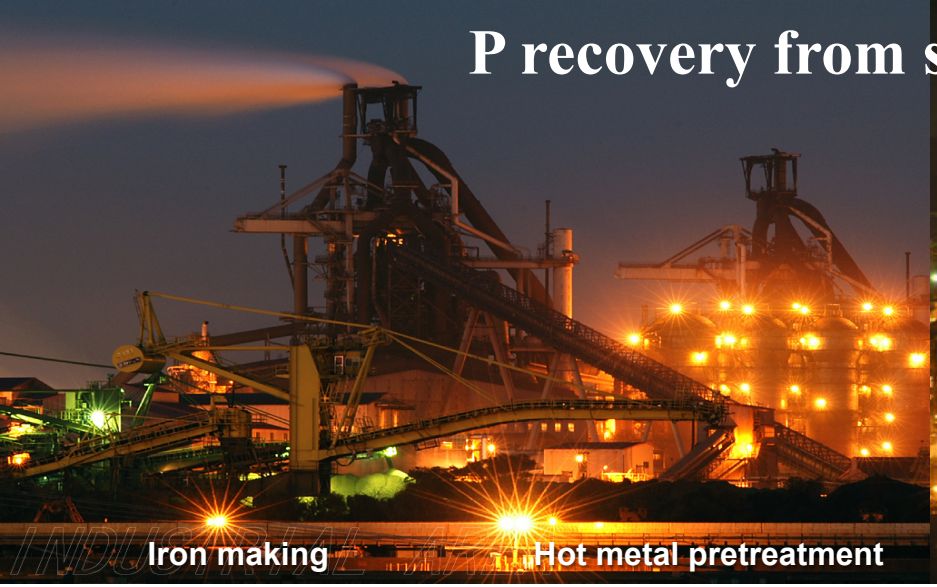
PRPCJ's tasks

- Bring together stakeholders
- Fill the gaps in knowledge
- Provide right information
- Raise public awareness
- Develop strategy for implementing P recycling
- Stimulate research and technology innovation
- Promote international cooperation
- Cooperate with local governments
- Create business opportunities

What Next?

- P recovery from steel-making slag
- Low-cost technology for P recovery
- Tailor Japan's policy to P recycling society
- Raise public awareness
- Bring economic benefits to industry
- Accelerate research and innovation
- Promote international cooperation

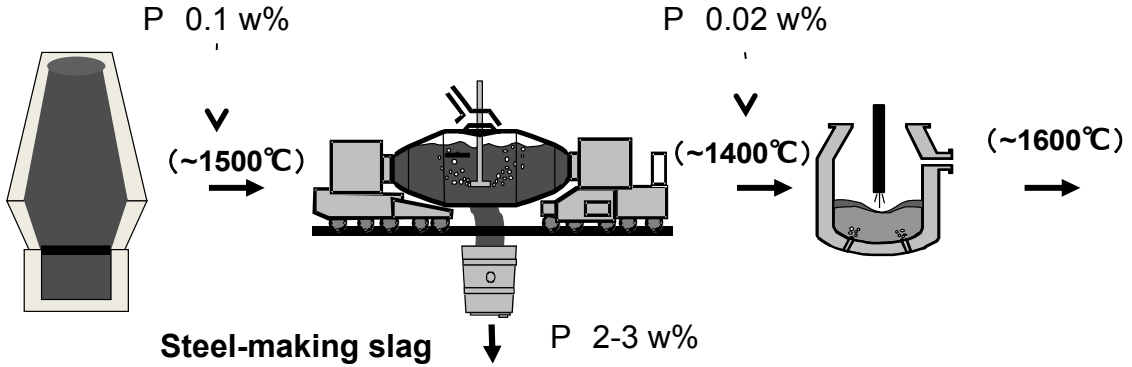
P recovery from steel-making slag

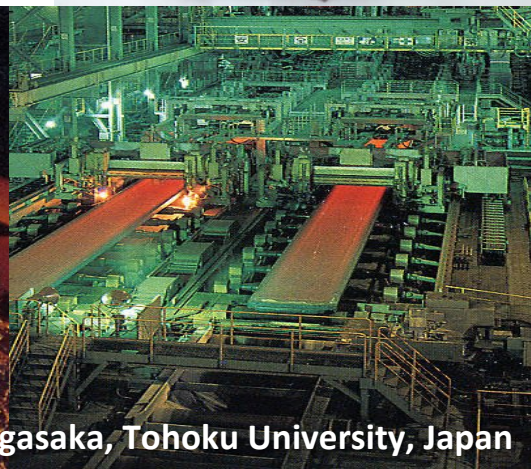


Iron making

Hot metal pretreatment

Basic oxygen steel making





From Prof. Tetsuya Nagasaka, Tohoku University, Japan

P recovery potential

Global iron ore production = 3.0 bln tn/y

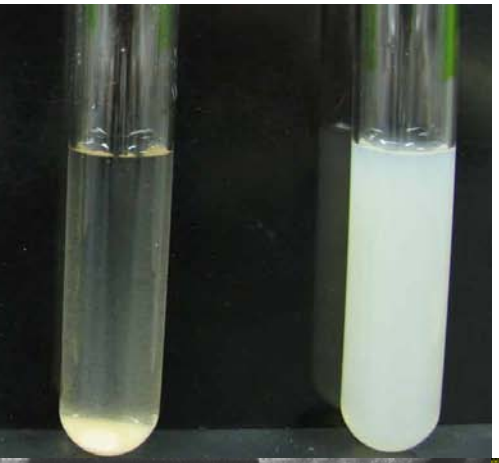
P content = 0.03%

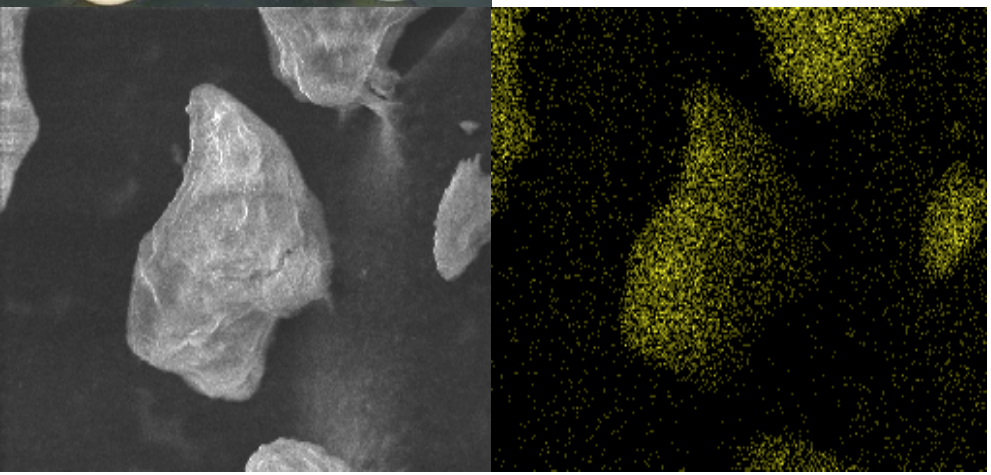
P in steel-making slag = 1.0 mln tn/y

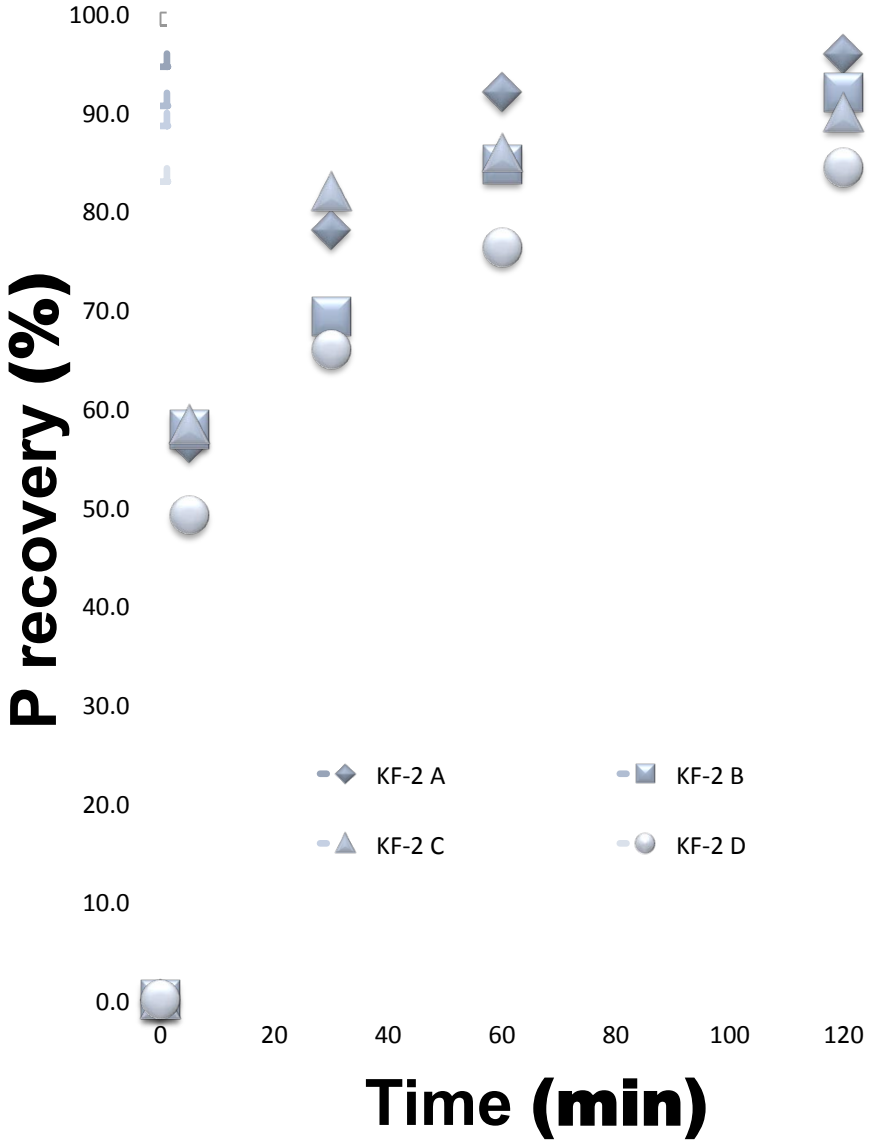
(global P production = 18.0 mln tn/y)

bln: billion, mln: million, tn: ton, y: year

P recovery using amorphous calcium silicate hydrates







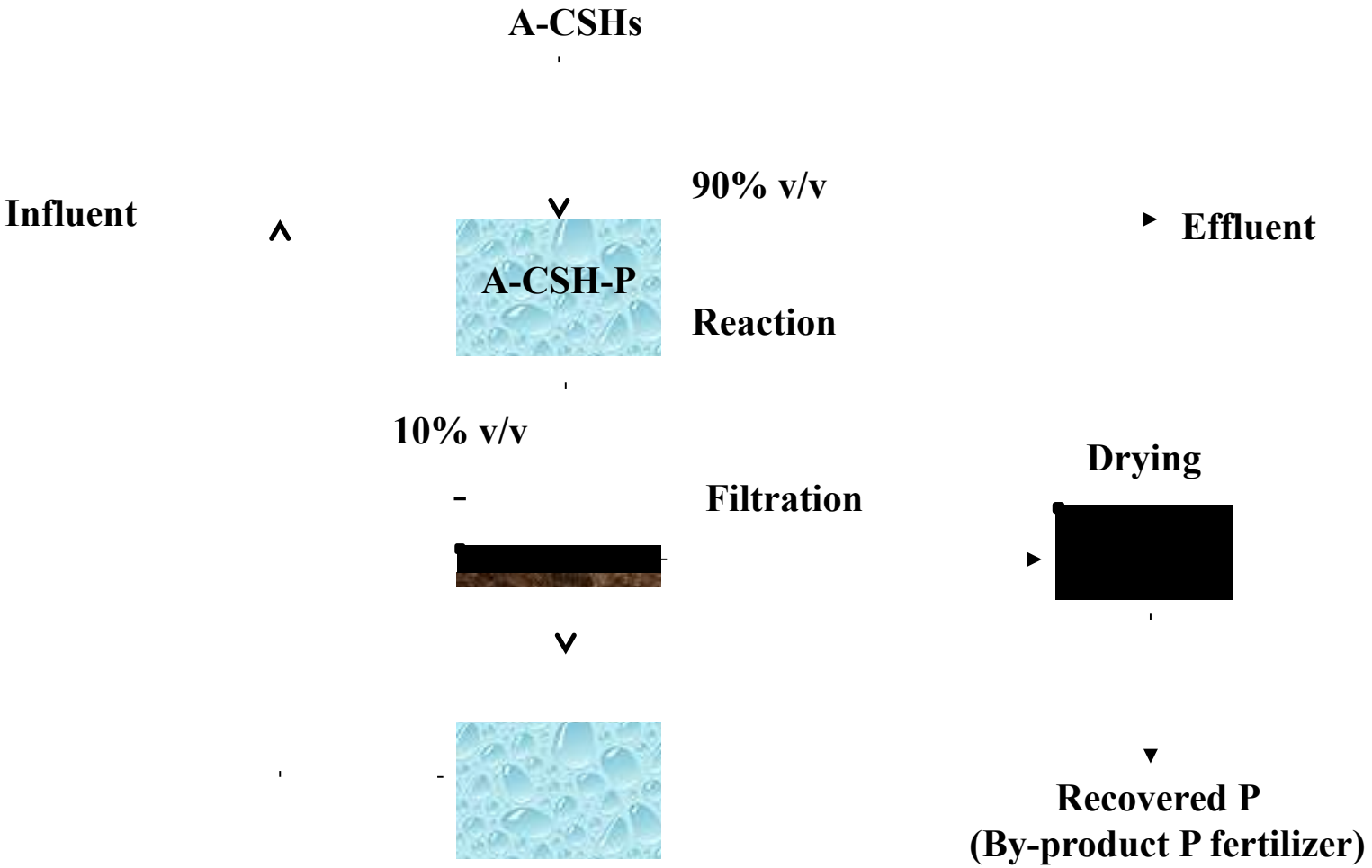
N and P contents after P adsorption

	Ca/P = 2	Ca/P = 1.5	Ca/P = 1
N	0.13	0.12	0.19
P_2O_5	15.6	18.3	22.0

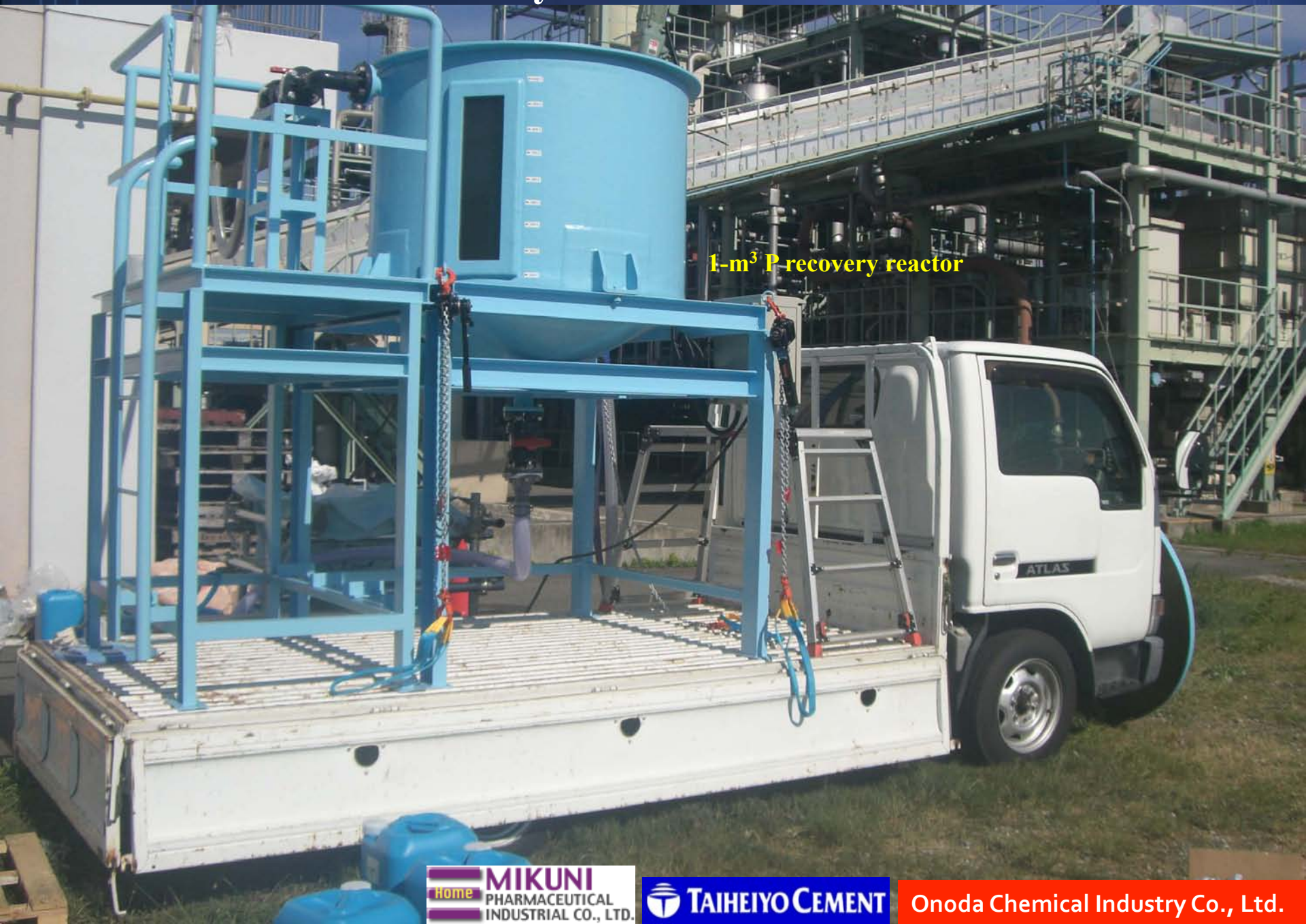
TAIHEIYO CEMENT

Onoda Chemical Industry Co., Ltd.

Simple cost-effective process



P recovery demonstration car



UNUSED PHOSPHORUS RESOURCE

- Eutrophic lake water and sediments
- Sewage sludge and sludge incineration ash
- Steel-making slag
- Waste from food and fermentation industry
- Waste from chemical industry
- Garbage and kitchen waste
- Agricultural and livestock waste
- Waste from high-tech industry
- Farmland soil
- Low-quality rock phosphate

PHOSPHATE REFINERY

QUALITY, QUANTITY, COST, AND MARKET

Yellow phosphorus

Phosphoric acid

Phosphate Refinery is the technology for recovering phosphorus from unused resources .

SECONDARY PRODUCT	USE APPLICATION	
Surface treatment chemicals	Automobile body Steel plate	
Etching agent	Computer Cellular phone Liquid crystal TV	
Food additive	Antioxidant Flavor enhancer	
Flame retardant	Home electronics Textile Printer	
Electronics, Battery	Electric Car Battery PC battery	
Intermediate of medicine	Antibiotics Medicine	
Chemicals, Pesticide	Detergent Shampoo	
Fertilizer, Feed additive	Phosphate fertilizer Mixed fertilizer	
Food oil refinery agent	Cooking oil Salad oil	

P emission in industry

- Steel-making industry (steel-making slag)
- Car industry (surface treatment chemicals)
- Electronics industry (etching agents)
- Food industry (food additives)
- Chemical industry (flame retardants)
- Alloy industry (exhaust gas)
- Fermentation industry (spent culture broth)
- Plating industry (plating wastes)
- Pharmaceutical industry (chemical wastes)

(*) : uses, products or wastes

Green industry

Industry participation is the key for P recycling.

PRPCJ

Phosphorus Recycling Promotion Council of Japan

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E-mail：prpc@jora.jp http://www.jora.jp/rinji/rinsigen/index.html (Japanese)

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http://www.bio.eng.osaka-u.ac.jp/be/eng/publications2.html