SELECTED JAPANESE ENVIRONMENTAL TECHNOLOGIES FOR GREEN INDUSTRY

An initiative of the United Nations Industrial Development Organization and the Government of Japan

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

GREEN INDUSTRY

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Introduction

Conscious of the adverse industrial, environmental and energy policy challenges being faced in developing and transition countries, UNIDO launched its Green Industry Initiative in 2009, as the sector strategy for achieving the overall aims of green growth and green economy in the manufacturing and associated sectors.

One of the main contributions of the Organization to accelerating the transition to sustainable development is defined by UNIDO, first and foremost, as an integral part and key dimension of Green Economy. As such, Green Industry enables industries to achieve low-carbon outcomes, resource efficiency, and better social and environmental performance of their operations and products, while saving money and increasing their competitiveness. Furthermore, a Green Industry approach stimulates the creation of new and sustainable jobs (i.e. green jobs), new business ventures and drives technology development and innovation. It involves a two-pronged strategy to create an industrial system that does not require the ever-growing use of natural resources and pollution for growth and expansion, rather is a proactive way to decouple environmental pressures from economic growth.

UNIDO's Green Industry Initiative launch took place in Asia at the Manila Green Industry Conference in 2009, which was hosted by the Government of the Philippines and co-organized by UNIDO in close partnership with the United Nations Environment Programme (UNEP), the Economic and Social Commission for Asia and the Pacific (ESCAP), and the International Labour Organization (ILO). At this occasion, 21 Asian developing countries agreed on the Manila Green Industry Declaration. Signatory countries committed to fostering the promotion and implementation of Green Industry concepts, methods, techniques, technologies and policies, in collaboration with their business sectors and other stakeholders, with active support from UNIDO and its partner agencies.

The Ministry of Economy, Trade and Industry (METI), the Government of Japan and UNIDO, organized the Tokyo Green Industry Conference (TGIC) 2011, between 16 and 18 November 2011, as a follow-up to the 2009 Manila Conference. The TGIC highlighted the availability of environmental and resource conservation techniques and practices that are good for business, environment and climate, employees, communities and consumers. During TGIC policy and business solutions were presented and debated to spread current proven techniques and technologies, and

enable innovation to deliver longer-term solutions that enable greater reductions in resource use and pollution intensity.

Through related activities organized in collaboration with the INCHEM 2011 Environmental Technology Exhibition, TGIC also provided opportunities to match environmental technology needs of participating developing countries with the international supply of Best Available Techniques (BAT) and Best Environmental Practices (BEP).

Green Industry entails a two-pronged approach to scale up and mainstream the application of proven resource efficiency methods and practices and environmental best practices and techniques:

A. Greening of Industries: to enable and support all industries regardless of their sector, size or location, to green their operations, processes and products by improving their environmental performance, and their resource and material efficiency, including water, energy and materials.

B. Creation of Green Industries: to stimulate the development of industries that provide environmental goods and services, and in that context, green jobs and technology transfer/technological change.

The UNIDO Green Industry Initiative creates awareness, knowledge and capacities, aimed at putting sustainable industrial development at the forefront of the global development agenda. Work is undertaken with governments to support industrial institutions, which in turn provide assistance to enterprises and entrepreneurs in all aspects relating to the greening of industry and creating green industries. In order to steer, guide and strengthen the implementation of projects in the area of Green Industry, UNIDO has established a global, high-level multi-stakeholder action partnership, the Green Industry Platform.

Today, with UNIDO's sound track record in responding to industrial development challenges, the initiative has received practical support and high-level commitment from Member States, UN-sister agencies, and other relevant stakeholders who stand ready to jointly advance the Green Industry agenda.

This Compendium is a follow-up endeavor to the 2011 Tokyo Green Industry Conference and a joint initiative of UNIDO and the Government of Japan. The Compendium showcases a selection of Japanese Environmental Technology that, broadly speaking, exemplifies the means and benefits achievable with Green Industry and which have been included in UNIDO's technical cooperation portfolio. Three selected exemplary technologies under the Greening of Industries and another three exemplary solutions under the Creation of Green Industries are herein presented. Each is explained and showcased separately in section II of this Compendium. Japan's environmental technology achievements are at the cutting edge of innovation and exemplary for Environmental Technologies and Techniques, which could be deployed and transferred to other countries to achieve their Green Industry agenda.

Background

The main focus of multilateral development cooperation continues to be the achievement of the Millennium Development Goals (MDGs). For industrial development cooperation, the eradication of poverty, spreading the benefits of globalization and preserving the environment are, and will continue to be, key challenges. In the last few years, keeping with its mandate, UNIDO coined the concept Green Industry to place sustainable industrial development in the context of new global sustainable development challenges.

Green Industry is a proven approach to attain sustainable economic growth and promote sustainable economies. It requires policymaking, improved industrial production processes and resource-efficient manufacturing.

The rising global population, the sky-rocketing emissions, the rapidly increasing global resource extraction (including water and energy), the fact that the world ecological footprint has now overtaken the planet's bio-capacity by some 40%, and the lack of finances and the necessary technologies, are all obstacles to achieving sustainable development and the internationally agreed development goals. In many countries, resource demands from present production and consumption systems are outpacing the renewal

capacity of natural resources and the capacity of local environment to absorb waste products and emissions. These facts, along with the global financial and economic crisis, make it necessary for countries to review their strategies and capitalize on the benefits achievable through Green Industry.

When looking more closely at the industrial sector, it is projected that global industrial production is to increase by 2050. The industrial sector uses more energy globally than any other end-user sector, and current consumption equals one-third of the world's total delivered energy. The manufacturing industry is responsible for a third of global greenhouse gas (GHG) emissions from fossil fuel use and industrial processes, one-fifth of global water use, and most of the raw materials used. Industry also causes emissions of other GHGs (methane, nitrous oxide and chlorofluorocarbons—gases that have higher global warming potential than CO_2).

Many industries use more materials and energy than their production processes would require, due to continued use of obsolete and inefficient technologies and methodologies. Producers and consumers have adopted patterns of production and consumption that do not take into consideration the limits of the planet's available resources and its assimilative capacity for emissions, a situation further complicated by continued population growth.

Climate change is one main consequence, but loss of biodiversity, land degradation and desertification, air pollution, surface and groundwater pollution, and chemical contamination, are all also important. With that in mind, current production systems are unsustainable because they do not allow today's resource needs to be met without jeopardizing the ability of future generations to meet theirs.

Hence the need for sustainable modes of production that are fundamentally based on efficient use of all natural resources. This is especially so in the developing world, which has the unique opportunity of avoiding the environmental pitfalls that industrialized countries have experienced in the course of their development; it can use past experience to build a "green industrial infrastructure" from the very outset.

Harnessing Environmental Technology, Science and Innovation

Science and technology are central to transforming industries towards sustainable patterns of production and economic growth.

New technology and innovation provide important leverage for Green Industry, both through the widespread transfer and utilization of environment, energy and resource conservation techniques, as well as through research led by sustainability and technology development. Enterprises and industries are becoming increasingly aware of the prospects that environmental technologies hold, not just in terms of environmental outcomes, but also the potential to reap economic rewards from increased efficiencies and new business opportunities.

Several technologies have potential as platforms to improve resource productivity and environmental performance across a range of industry sectors, for example green chemistry, advanced separation (including membrane technology), and bio- and nanotechnology. These platform technologies can complement specific technologies. By effectively utilizing the existing stock of industrial technology, developing and emerging economies stand to benefit from improvements in their national systems of innovation, particularly by enhancing collaboration between businesses, academia and the providers of technology, management, engineering and financial services, and civil society at large.

In this context, National Cleaner Production Centres (NCPCs), which promote Resource Efficient and Cleaner Production (RECP) practices and methods, can play an important role in raising awareness, disseminating information (including through clearinghouses), and capacity building, policy advice, and transferring and deploying appropriate technologies to industries, particularly to Small and Medium Enterprises (SMEs).

For developing countries, capacity development and the diffusion of environmental technology are particularly important areas for government assistance. Most developing countries are not yet at the cutting edge of science and innovations, and rely on technological advancements though the adaptation and adoption of pre-existing but new-to-the-country or new-to-the-firm technologies. If countries are to harness the benefits of environmental technologies they need the support of integrated and adaptable science systems that can respond quickly to minimize any environmental risks while maximizing economic opportunities.

Additionally, governments can support the development of new environmental technologies by investing in the development of science platforms, from which environmental technologies can be leveraged. There is a need to foster partnerships with industry and end-users to ensure investments result in relevant and/or commercially viable technologies. Networks and technology transfer mechanisms remain of key importance, particularly for

developing countries that struggle to finance their own research and development programmes.

Finally, greater coherence between environmental and innovation policies needs to be established. Innovation policy has long underplayed the issue of environmental and resource conservation and sustainability at large, mainly because of the misperception that it has weak links with commercial interests and because of the lack of recognition that multidisciplinary approaches are needed. The role of environmental technologies as an enabler of resource and production efficiencies, and new market opportunities should be reflected in science and innovation strategies.

UNIDO GREEN INDUSTRY INITIATIVE

Relationship with the 'Green Economy' and Sustainable Development

Like the 'Green Economy' concept, 'Green Industry' is seen as an important and practical pathway towards achieving sustainable development. The thrust of 'Green Economy' is achieving improved human well-being and social equity, while simultaneously diminishing environmental risks and reducing ecological scarcities. Commensurately, 'Green Industry' transforms manufacturing and allied industry sectors by introducing more efficient, resource-productive and responsible use of raw materials so that they contribute more effectively to sustainable industrial development. It is about doing more, and better, with less. Green Industry is thereby the sector strategy for the realization of Green Economy and Green Growth, and ultimately, sustainable development.

Unlocking Development Opportunities

There are multiple benefits from pursuing a Green Industry approach. Green Industry offers a practical pathway to long term economic growth and sustainable development, as it unlocks development opportunities whereby enterprises improve their resource productivity and environmental performance (greening of industry), and establish new operations that deliver environmental goods and services (creating green industries).

This is imperative from triple bottom-line economic, social and environmental perspectives, particularly as Green Industry supports:

1. ***Income and employment creation***: advanced waste management and recovery services, renewable energy projects, and provision of other environmental goods and services creates jobs, and provides a source of income, including for poor people with lower formal skill levels;

2. ***Competitive and sustainable business***: reduced operational costs due to the reduced consumption of materials, energy and water, and of minimization of waste and emission generation, while assuring continuity of trade in light of tightening buyer requirements for environmental and social disclosure, and performance;

3. ***Innovative and value-adding products***: mainstreaming environmental and social concerns into product development results in innovative products that benefit consumers and society at large, while not jeopardizing the quality of life of producers and of the planet Earth;

4. ***Natural resource security***: reduced use of water, materials and fuels eases the pressures on these already scarce resources, which are all expected to become scarcer in years to come if present population, urbanization and development trends continue as projected into the future;

5. ***Mitigation and adaptation to climate change***: reduced greenhouse gas emissions from energy and non-energy sources along with better preparedness for the impacts of climate change on the operations of enterprises, the availability of their inputs and the markets for their products and services;

6. ***Environmental management***: reduced generation of waste and emissions lessens the pollution burden on the natural environment and biodiversity; and,

7. ***Industrial and chemical safety***: better operated, maintained and managed plants that use chemicals responsibly pose fewer risks to workers and communities.

Charting the Path

Green Industry can be achieved through a number of concerted actions:

A: Greening of Industries

Enable and support all industries regardless of their sector, size or location, to green their operations, processes and products to:

1. ***Use resources efficiently***: increase the productive use of materials, water and energy in industrial production, through such approaches as: dematerialization of products and value chains; use of materials with longer service lifetime; replacement of virgin materials with recycled materials; recycling, reuse and recovery of materials, energy and water; and use of materials, water and energy from sustainably managed and/or low-impact sources;

2. ***Minimize the generation of wastes and emissions***: minimize and where possible eliminate the creation of waste and emissions within factories, through such approaches as: improvements in process operation, monitoring and maintenance; waste minimization; application of advanced process technologies with higher efficiency and specificity; and recycling, reuse and recovery of process streams; and,

3. ***Minimize risks associated with chemicals and (hazardous) wastes***: minimize risks associated with production, use, and disposal of chemicals, through such approaches as: sound management of chemicals; phasing out of toxic and other environmentally harmful substances (including those contributing to ozone layer depletion and/or climate change); application of Best Environmental Practices and Best Available Techniques to prevent unintended formation and emissions of POPs and other hazardous pollutants; replacement of chemical processes by non-chemical processes (biological, physical, etc.); and replacement with safer, more specific and/or more effective alternative chemicals.

B: Creation of Green Industries

Establish and expand (new) green industries that supply environmental goods and services to:

4. ***Reduce, Reuse and Recycle waste materials***: support industries to develop and deliver advanced integrated waste management, recycling and resource recovery technologies, services and systems, for municipal, commercial, industrial, construction, demolition and other specific waste streams, and produce thereof reliable supplies of recycled materials and products;

5. ***Improve industrial energy efficiency and make use of renewable energy***: support industries to deliver technology, equipment, products, management systems, know how and/or services that enhance industrial energy efficiency and the use of renewable energy (solar, bio- etc.) or other low carbon energy sources (in particular waste heat); and,

6. ***Collect, manage and dispose (hazardous) wastes and/or emissions in environmentally compatible ways***: support industries to develop and deliver technology, equipment, products, management systems, know how and/or services that collect, manage and dispose, without threats to the environment, (hazardous) wastes and/or emissions, including for example chemical and medical wastes, electronic waste, etc.

C: Enabling Framework

Create an enabling framework that encourages businesses individually and collectively to adapt and adopt Green Industry to:

7. ***Mainstream and embed Green Industry in industrial and related policies and strategies***: ensure that Green Industry is a cross-cutting priority in competitiveness, innovation, trade and fiscal policies, through approaches such as setting targets for sustainable production, dematerialization and recycling; employing customized mixes of information-based, regulatory, voluntary and market-based instruments; and encouraging, supporting and rewarding industry and business-led initiatives;

8. ***Foster access to appropriate and affordable technology***: harness the potential of environment, resource conservation and energy technologies and techniques, through support for technology

diffusion and deployment; technology assessment and road-mapping; and applied research and technology development;

9. ***Enable access to affordable financing***: support financial markets to develop and provide financing for Green Industry in forms suitable to the investment needs and risks in particular of Small and Medium Enterprises (SMEs), and where appropriate ensure appropriate leverage on available public funding; and,

10. ***Create human and institutional capacity***: invest in dialogue with business and civil society on the need for and opportunities of Green Industry, in tandem with targeted information dissemination; professional, management and vocational training; and the establishment of support institutions with advisory capacity on Green Industry.

Getting Started

Green Industry initiatives are to be customized to the country's industrial and development needs, its environmental, resource and climate considerations, and other relevant national factors. To catalyze a widespread transition to Green Industry however, a mix of the following elements deserves consideration:

1. ***Industrial Policy and Strategy***: strengthening and creating trade, technology, training, economic, fiscal and/or other incentives for greening of industries and creation of green industries in relevant policies and strategies for industrial development, as well as the institutions for their implementation, monitoring and enforcement;

2. ***SME Support Services***: creating and strengthening the support structure for assisting industry, in particular Small and Medium Enterprises, with the adaptation and adoption of Green Industry including accessing, adapting and adopting the necessary technology and financing;

3. ***Transformational Learning and Innovation***: developing and disseminating the knowledge, methods and processes for break-through, transformational Green Industry methods and technologies, through sustainability led education, training and innovation initiatives; and

4. ***Replicable Models***: developing, trialling and promoting replicable models for high-impact Green Industry solutions, for example for Eco-Industrial Parks and climate-resilient industries.

UNIDO GREEN INDUSTRY PLATFORM

UNIDO has launched at the occasion of the Rio+20 United Nations Conference on Sustainable Development the global high-level multi-stakeholder action partnership, the Green Industry Platform, to strengthen the implementation of its Green Industry initiative.

Mission of the Green Industry Platform

The Green Industry Platform is a global, high-level multi-stakeholder action partnership intended to act as a forum for catalyzing, mobilizing and mainstreaming action on Green Industry around the world. It provides a framework to bring together governmental, business and civil society leaders in order to secure concrete commitments and mobilize action in support of the Green Industry agenda, i.e. *greening the manufacturing process* and *creating green industries for production of goods and services for domestic use or export*. By encouraging the more efficient use of energy and raw materials in manufacturing processes services, the Platform will contribute both to cleaner and more competitive industrial development, and will help reduce pollution and reliance on the unsustainable use of natural resources.

Objective of the Platform

The Platform creates new green industries and helps existing industries improve their contributions to societal and ecological protection. It achieves this by providing a framework where signatory organizations can develop road maps to integrate Green Industry policies and practices in organizational strategies and business plans, share and profile best practices to move beyond 'business as usual', and drive forward technological development, application and innovation under the green industry initiative.

Key features of the Platform

The Platform has several unique features, including:

- ***Mandate***: It is the first and largest purpose-built, multi-stakeholder framework with a focus on Green Industry. An action-oriented Platform, its goal is to inspire measurable progress towards Green Industry and to ensure that the emerging 'Green Industry revolution' is given the policy profile and coherence it deserves.

- ***Membership Model***: While the Platform is hosted and chaired by UNIDO, it has a multi-stakeholder governance and membership model to promote diverse, innovative and effective approaches.

- ***Materials***: The Platform helps linking existing data resource bases and develops its own materials and communication mechanisms, including a web-based portal to share information on relevant policies, technologies and developments.

For more information, visit:
www.unido.org/GIPlatform or contact:
giplatform@unido.org

Overview of the six showcased Japanese Environmental Technologies

GREENING OF INDUSTRIES

1. Resource Efficiency

TECHNOLOGY: Smart Grid Engineering: Power Router for an Electricity Cluster Oriented Network

COMPANY: VPEC Inc.

www.vpec.co.jp/index_e.html

2. Prevention of Wastes and Emissions

TECHNOLOGY: Mobile ODS Reclaimation and Decomposition Unit to Purify and Destroy Refrigerants using Electrostatic and Plasma Technologies

COMPANY: Asada Corporation

www.asada.co.jp/english/index.html

3. Safe Chemicals Management

TECHNOLOGY: Green Chemical Management Technologies for Acetic Acid Production and Sulfur-Free Diesel Production

COMPANY: Chiyoda Corporation

www.chiyoda-corp.com/en/

CREATION OF GREEN INDUSTRIES

4. Reduce, Reuse and Recycle (3Rs)

TECHNOLOGY: Rainwater Storage and Usage System

COMPANY: Totetsu Mfg. Co., Ltd.

www.totetu.com/en/

5. Pollution Control

TECHNOLOGY: Jarikko Wastewater Purification System

COMPANY: Aquatech, Ltd.

www.aquatech.co.jp/eng/index.html

6. Energy-related Green Industries

TECHNOLOGY: Gasification Power Generation

COMPANY: Kinsei Sangyo Co., Ltd.

www.kinsei-s.co.jp/index2.htm

TECHNOLOGY

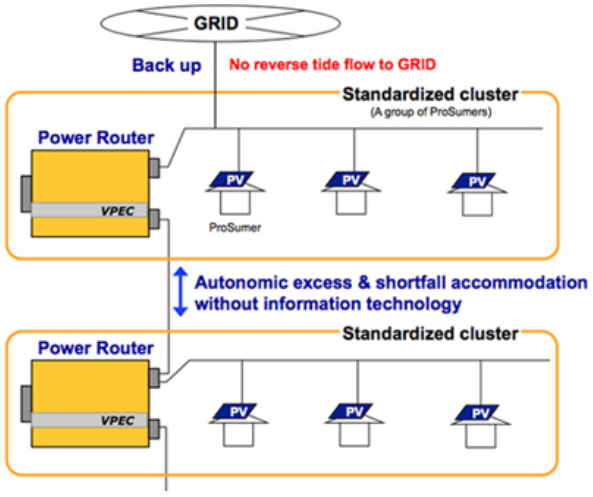
Smart Grid Engineering: Power Router for an Electricity Cluster Oriented Network

COMPANY

VPEC Inc.
www.vpec.co.jp/index_e.html

INTRODUCTION

The Power Router (PR) developed by VPEC Inc. is used to autonomously control and disperse the electricity flow from one local cluster to another. A cluster is composed of approximately 10-30 households. PR is the key technology used in VPEC's ECONETWORK®, which is a network of ProSumers, making up a Smart GRID. This is a new architecture for the distribution of electricity that is locally generated and for localized consumption from renewable energy sources such as solar photovoltaic, geothermal, micro-hydro, solar thermal, and wind turbines. The main characteristic is to make the massive deployment of Renewable Energy Sources available by eliminating the reverse tide flow to the conventional energy GRID, and to accommodate excess and shortfall.



PROCESS

ECONETWORK® deploys the renewable energy in a clustered flow. It can start in small units and then expand progressively as needed. This can reduce the cost and complexity of conventional electrification and can help contribute to building a low carbon society. A cluster uses the combination of a generator and/or storage, and an appliance with a Power Router.

The Power Router consists of two inverters and a battery that accommodate the transfer of electricity within and amongst the clusters without the use of expensive telecommunication lines. The simple, yet innovative method, allows for one inverter to control the frequency of one of the clusters, related to the state of charge of the battery, and the other inverter controls the interconnection of the two clusters based on the frequency difference. This is done in real time, automatically and autonomously.

COMPETITIVE ADVANTAGE

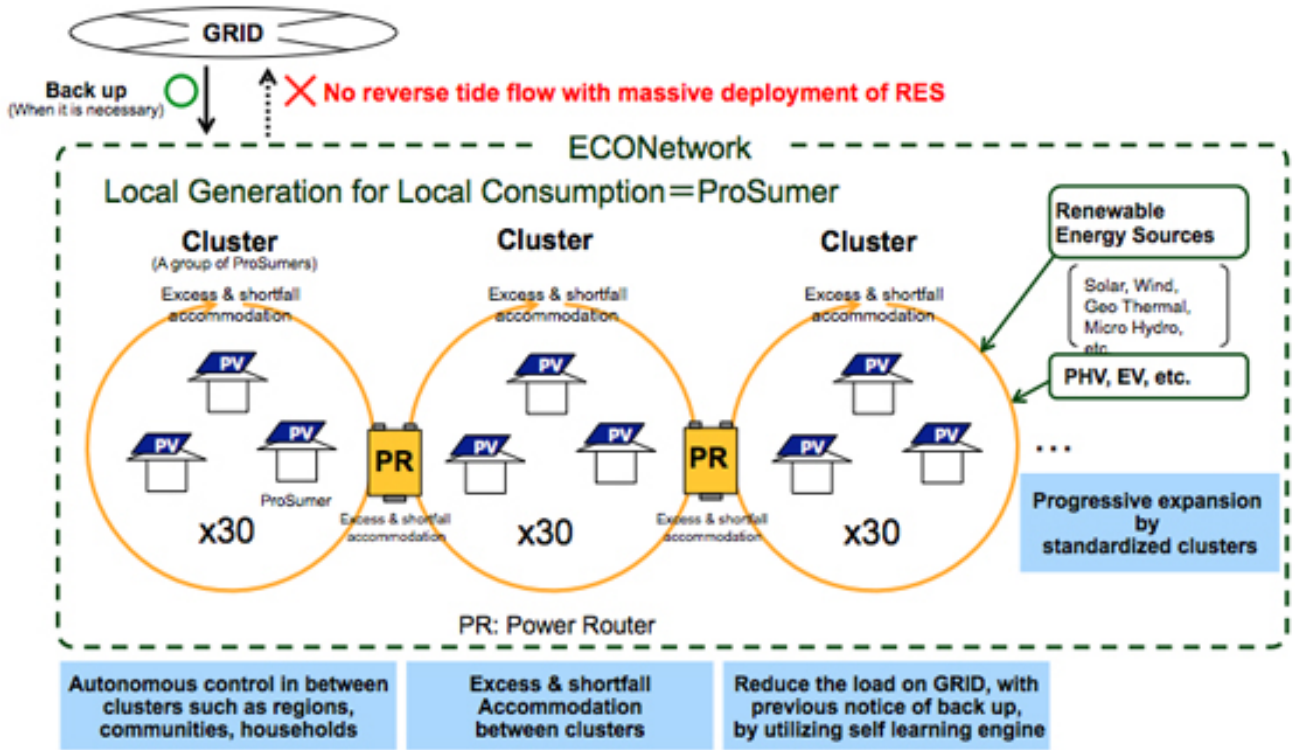
This technology allows for electrification in rural areas with lower costs than other methods due to two factors. The first factor being that that the initial investment cost is significantly reduced due to the progressive expansion of standardized clusters. Secondly, the power router technology does not require any type of telecommunication to

be present or used as a prerequisite, as is the case with other smart GRID technologies.

In the case or urban areas the loosely combined application of ECONETWORK® and the conventional energy GRID (co-existence) allows for an optimal scenario. It allows for consumers to know what is available to them in terms of energy resources in real time, thus enabling them to control and decide over their consumption. The conventional energy GRID can have more capacity when used in combination with ECONETWORK® because the consumption is locally clustered (cluster of renewable energy sources), the energy transfer is thereby reduced (generating an estimated minimum 5% of energy efficiency by the reduction of the volume in energy transfer and another 15% reduction given the consumers involvement to procure energy on a demand-driven basis rather than on predictions) and finally CO_2 emissions are lowered.

Energy security and energy independence is warranted for the consumer in the case of a traditional electricity blackout, as well as lower energy costs since the conventional energy grids are dependent on the cost of fossil fuels. The system is easy to procure and installation is also simple.

Contact information:
Mr. Satoshi Nagata
info@vpec.co.jp
+81-3-5532-8525



Prevention of Wastes and Emissions

TECHNOLOGY

Mobile ODS Reclaimation and Decomposition Unit to Purify and Destroy Refrigerants using Electrostatic and Plasma Technologies

COMPANY

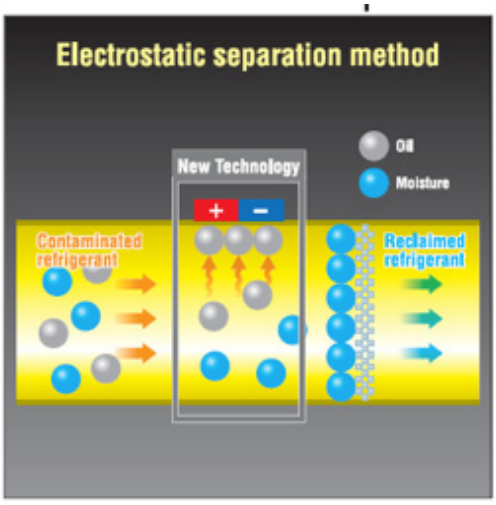
Asada Corporation
www.asada.co.jp/english/index.html

INTRODUCTION

Asada Corporation's technology is available in two separate models. It contributes in that recovered fluorocarbons are either reclaimed for reuse or destruction in order to prevent atmospheric release. The application of this technology is particularly suitable for Montreal Protocol ODS related projects. The reclaim technology equipment is available as mobile reclaim units that can easily be transported and that use an electrostatic separation process to purify the refrigerants or as centralized stationary purification centers. The ODS destruction technology equipment is also mobile and uses a method to destroy unwanted ODS through plasma torch decomposition. End products are calcium-chloride and calcium-fluoride. It is suitable for operation in a factory or industrial site where it is impossible to remove refrigerants for the specific site.

PROCESS

1. ODS reclaim technology: The "Eco-cycle Aurora" is used to recover and reclaim all kinds of refrigerants from A/Cs or other chillers using an electrostatic separation method. It is an on-site or cylinder to cylinder system, with a 200g/min capacity.

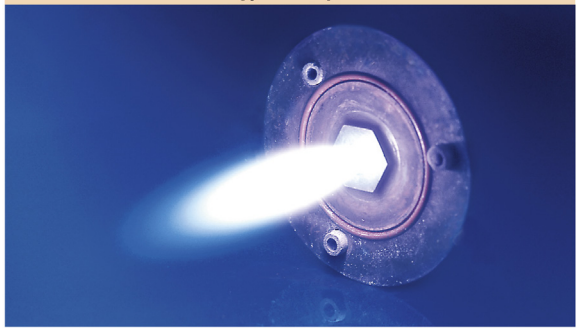


The purification can be done through recycling, which is a filtering process that reduces potential contamination to an unspecified level; and reclaim, which is a purification process that brings the refrigerant back to the level of properties of a new refrigerant.

Description	ECOcycle Aurora
Code No.	AR180
Applicable refrigerant	R12, R22, R500, R134a, R404A, R410A, R507A, R509A, and more.
Recovery method	Liquid recovery method (Vapor recovery also available)
Reclaim method	Electrostatic separation method
Voltage	Made to order
Compressor	560W / Oil less compressor with ceramic bearing
Reclaim capacity	200 g /min for all kinds of refrigerant
Oil separator	Heat exchange style / capacity 2L
Dimensions	(L)582 x (W)600 x (H)960 mm
Operating temperature	0 - 40°C
Weight	58kg

2. ODS destruction technology: The "Plasma X" which is a mobile type of ODS destruction machine (refrigerant decomposition device) is suitable for a small volume of unwanted ODS by using plasma with a highly efficient 2kg/hour capacity for R22 and R134a (HCFC, HFC) and 1kg/hour for R12 (CFC).

Asada Plasma technology decompose fluorocarbon 99.9%



· Plasma decomposes fluorocarbon and detoxifies as calcium fluoride and calcium chloride.

Fluorocarbon (10kg)

Calcium fluoride
Calcium chloride (approx. 30kg)

Description		Plasma X
Code No.		FP100
Applicable refrigerant		R12, R22, R134a, R407C, R410A, and more
Method		Torch Plasma
Voltage		3 phase 200V (*)
Processing Capacity		2kg / hour (R22)
		2kg / hour (R134a)
		1kg / hour (R12)
Decomposition Rate		More than 99.9%
Dimension	Decomposition unit	(L)1500 x (W)930 x (H)1526mm
	Dehydration unit	(L)960 x (W)800 x (H)2075mm

*Other voltages available

COMPETITIVE ADVANTAGE

Both machines are easy to transport due to their compact size. Further to this both technologies are easy to maintain and have safe and automatic operation features. The "Eco-cycle Aurora" uses high purity and speedy reclaiming techniques by electrostatic separation and is applicable to high pressure refrigerants like R410A, in a compact and lightweight package. "Plasma X" has a very accurate destruction with a decomposition rate of 99.9%, and an added advantage of a low investment cost. Currently decomposition is usually carried out at separate plant facilities that require large spaces which is not the case with this technology.

Contact Information
Mr. Satoru Shidara
trade@asada.co.jp
+81-52-914-1062

Safe Chemicals Management

TECHNOLOGY

Green Chemical Management Technologies for Acetic Acid Production and Sulfur-Free Diesel Production

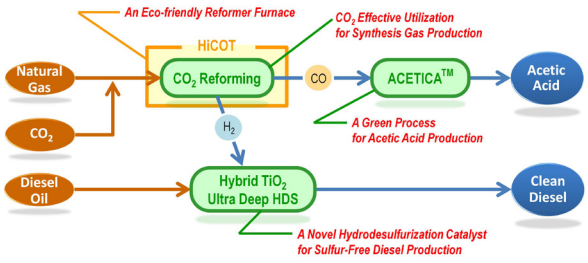
COMPANY

Chiyoda Corporation
www.chiyoda-corp.com/en/

INTRODUCTION

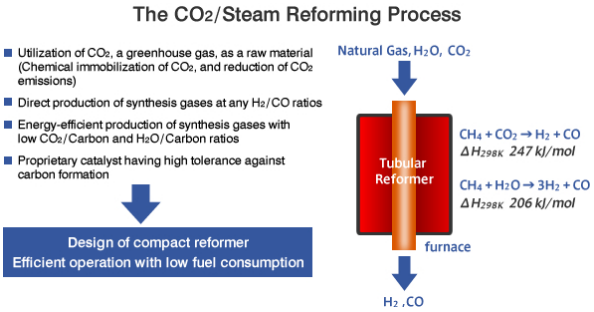
Chiyoda develops green chemical management technologies and offers them to clients through their Engineering business. As one example, acetic acid, which is an important chemical reagent and industrial chemical and clean diesel, can be produced from natural gas, CO_2, and diesel oil with Chiyoda's green chemical management technologies described below:

- ***CO_2 reforming process***: A reforming process for synthesis gases (H_2 and CO) production with utilizing CO_2. HiCOT reformer furnace: an eco-friendly reformer furnace.
- ***ACETICA***: A green process for acetic acid production.
- ***Hybrid TiO_2 catalyst***: A novel hydrodesulphurization catalyst for sulfur-free diesel production.



PROCESS

CO_2 reforming process: Chiyoda's CO_2 Reforming Process reuses efficiently CO_2 emitted from various industrial processes or enables the development of low-quality natural gas fields containing CO_2. This reforming process can produce synthesis gases[1] more efficiently than conventional steam-reforming processes. This process uses CO_2 as a raw material and uses Chiyoda's unique reforming catalyst, thereby achieving high energy efficiency. Therefore, this reforming process is an environmentally-friendly technology due to significant reduction of carbon dioxide emissions.

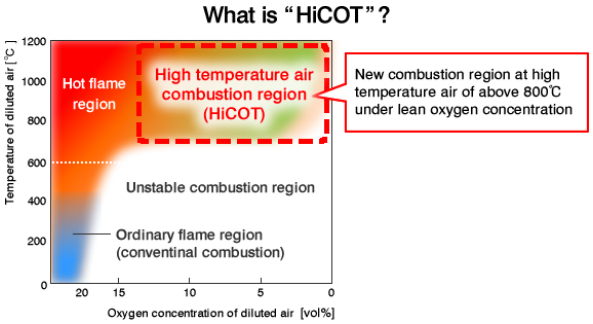


1 Gas mixtures consist of hydrogen and carbon monoxide. Synthesis gases are used as raw materials for producing liquid fuels (GTL, DME, etc.) and various chemicals. The produced liquid fuels contain no sulfuric and nitrogenous compounds, so that exhausted gases after combustion become extremely clean.

HiCOT reformer furnace: Chiyoda's High Temperature Air Combustion Technology (HiCOT)[2] is an innovative technology which has following characteristics:

- Fuel saving / CO_2 reduction by waste heat recovery of high temperature exhaust gas with regenerative burners
- Ultra-low NOx emission level by uniform temperature distribution without local peak temperature zone inside fire box
- Downsizing of convection section by its very high radiant efficiency.

By using HiCOT reformer furnace, hydrogen and synthesis gas production can be carried out with high radiant heat efficiency.



The ACETICA™ PROCESS is a process to produce acetic acid from methanol and carbon monoxide. With a unique line of technologies including high-performance resin-supported rhodium catalysts and bubble column loop reactors, this differentiates from other similar processes.

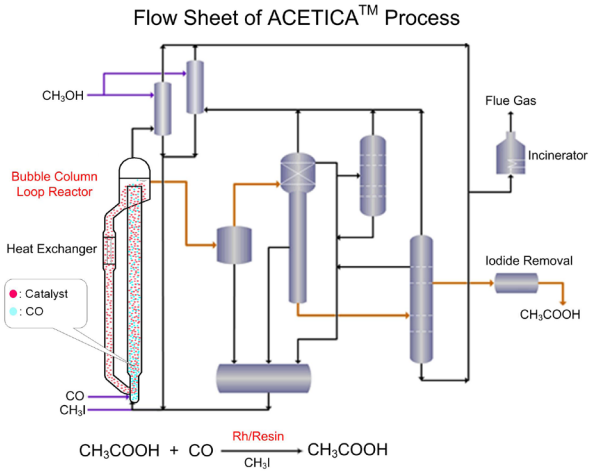
High-performance resin-supported rhodium catalyst: Fixing the rhodium complex catalyst on the Chiyoda proprietary resin exhibits the following advantages:

- Without the solubility limitations, the amount of catalyst in the reactor can be raised to promote acetic acid production rate.
- The loss of expensive rhodium by precipitation can be lowered.
- As the amount of water can be decreased to a minimum level required for the reaction, the refining cost of the product acetic acid can be reduced.

Bubble column loop reactor technology: ACETICA™ PROCESS adopts a bubble column loop reactor designed for effective usage of resin catalysts. The bubble column loop reactor has the following features:

- High contact efficiency among the gas-liquid-solid three phases
- Because there are no rotating elements, high air-tightness is achieved. Resin erosion can also be reduced.
- Reaction heat can be easily removed by installing a heat exchanger at the down-comer unit, achieving a more precise control of reaction temperature.

Schematic illustration of the acetic acid production process:



2 The combustion technology utilizes a new combustion region at a high temperature of air above 800°C under lean oxygen content where the burner flame spreads entirely in the combustion chamber and the flame becomes invisible. The high temperature of air combustion of this HiCOT reformer furnace is achieved by regenerative burners recovering waste heat of flue gas from the radiant section. Such combustion conditions provide uniform temperature distribution in the combustion chamber

The Hybrid TiO_2 catalyst is a unique diesel oil desulfurization catalyst that uses titania carriers with a combination of its own applied technology for alumina carrier pore control that has been developed since the 1970s.

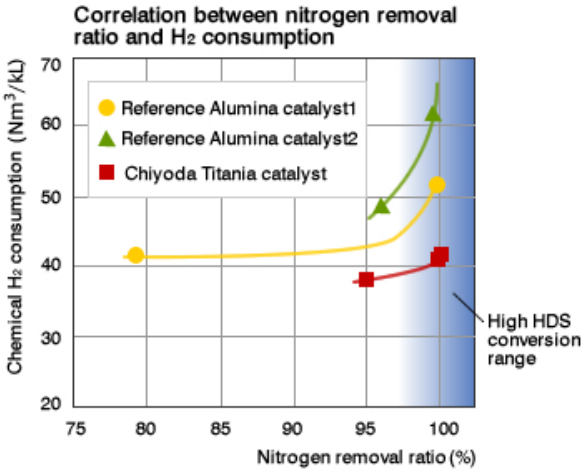
HDS: Hydrodesufurization

Titania Catalyst Carrier: The conventional understanding is that titania catalysts have a higher activity per unit surface area than alumina catalysts, but increasing the surface area has been a technical challenge. Chiyoda successfully developed a titania catalyst with a larger surface area and using it, developed a highly efficient desulfurization catalyst that can produce sulfur-free diesel oil.

Stable activity, high denitrogenation selectivity, and low hydrogen consumption: This catalyst makes desulfurization possible at a low reaction temperature, where its deactivation becomes slow, providing a longer catalyst life. In addition, this catalyst brings about highly efficient denitrogenation activity and reduced hydrogen consumption at the same time, completely contradicting previous understanding in this field (see the graph above). This makes it possible to reduce hydrogen consumption, relative to conventional alumina catalysts, under sulfur-free reaction conditions.

COMPETITIVE ADVANTAGE:

CO_2 reforming process: Chiyoda's CO_2 reforming process realizes CO_2 efficient utilization, and enables to produce synthesis gas in wide range of Hydrogen/Carbon monoxide ratios and can be applied to chemical syntheses such as acetic acid synthesis, oxosynthesis, and GTL, etc. In addition, it is possible to stably operate under low Steam/Carbon and CO_2/Carbon conditions whereas in comparison a stable operation by conventional steam reforming process is impossible.



HiCOT reformer furnace: The three main merits are fuel saving/reduction of CO_2 emission, ultra-low NOx emission level, and downsizing of convection section.

ACETICA: Energy saving and reduction of noble metal loss will be achieved by utilizing a unique bubble column loop reactor and proprietary high-performance catalyst support resin.

Hybrid TiO_2 catalyst: Hybrid TiO_2, developed by Chiyoda with applying original catalyst preparation technology, has both desulfurization performance of TiO_2 and functions as a catalyst support of Al2O3. Due to the synergy effect of TiO_2 and Al2O3, Hybrid TiO_2 shows higher desulfurization activity than conventional catalysts. Due to its high activity, Hybrid TiO_2 catalyst can make it possible to conduct ultra deep desulfurization of diesel oil under low temperature conditions.

Contact information
Mr. Makoto Yasui
myasui@ykh.chiyoda.co.jp
+81-45-225-7777

TECHNOLOGY
Rainwater Storage and Usage System

COMPANY
Totetsu Mfg. Co., Ltd.
www.totetu.com/en/

INTRODUCTION

The Company Totetsu has created a complete product line for the full scale collection and use of rainwater. Their technology contributes to solving the manifold pressing water shortages that many areas are facing.

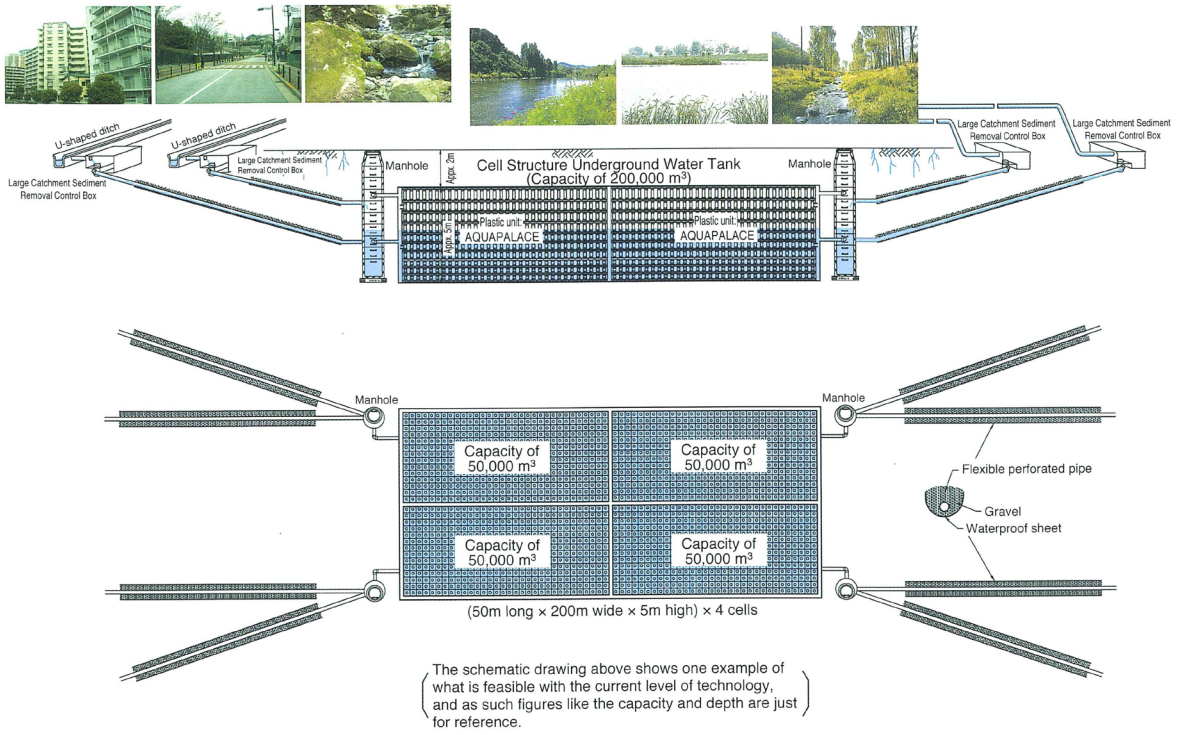
Since rainwater is in effect distilled water, it is a valuable resource that is extremely pure, that can be obtained using a minimum of energy resources and without generating harm to the environment. It is a viable alternative to using recycled wastewater or desalinating seawater as both these options require vast amounts of energy in their cleaning processes.

Conventional water reservoirs often lose water through evaporation, and they easily become tainted by foreign matter mixing in the water. This system also allows for the underground storage tanks to be installed near rivers. With this storage system, rainwater that falls in each designated area is stored right there and used in that local reality. Nonetheless, there is also the possibility to connect a collection pipe to a large or small river nearby to be able to tap into additional water resources when the river water levels are high in rainy seasons. This is also useful to control the flood risks that certain areas around large rivers often face.

PROCESS

The Totetsu technology collects, purifies and stores the rainwater in specifically designed plastic water-proof underground storage tanks. These storage tanks are resistant to earth pressure and earth-quakes. The purified water (99.5% of contaminants can be removed) is suitable for daily life needs, agriculture and industry. It will need to undergo an additional filtration and sterilization process to obtain drinking water quality, yet this is possible if needed. The stored water in these underground storage tanks can easily be supplied to the end-used via a power pump or also via manual human power if necessary which makes the system applicable for non-electrified areas.

Creating water source to replace dams and reservoirs



The schematic drawing above shows one example of what is feasible with the current level of technology, and as such figures like the capacity and depth are just for reference.

COMPETITIVE ADVANTAGE

This is a good solution to harvest and store water resources in areas where there are water shortages or where conventional water supply systems are not in place (i.e. remote rural areas). Additionally, the technology allows for the collection of vast amounts of rainwater and has the flexibility that it can collect rainwater from a series of different sources, such as rivers, drainage systems, waterways, etc.

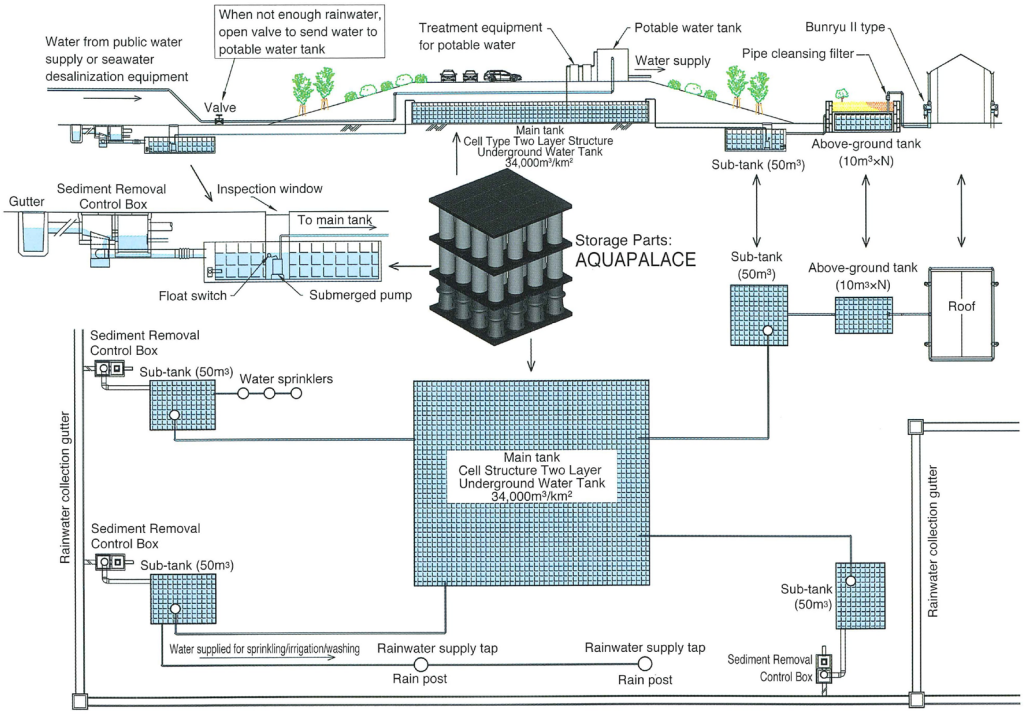
The initial investment for the procurement of the storage tank for the rainwater, inclusive of the special sealing sheets to avoid leakage, is lower than that of tanks that are made of concrete and/or steel. The type of plastic construction and integrated underground positioning contribute to an excellent stable structure that is resistant to earth pressures, impacts and earthquakes.

This enables the construction of large-scale underground storage tanks that have a depth of more than ten meters. Further to this, the period of construction for this storage tank is much shorter than for those aforementioned (thereby also reducing costs), and customers are given the flexibility to select the shape of the tank according to their specific site requirements.

Most of the piping used in the system is recyclable. The operational cost to purify rainwater is close to zero when in comparison to the purification of waste or seawater using other methods that are very energy intensive. There is a suggested interval of three to six months to carry out maintenance procedures that are low in cost.

Contact information
Mr. Seiichiro Takai
seiichiro.takai@totetu.com
+81-3-3493-5911

Building a town with on-site rainwater use



TECHNOLOGY
Jarikko Wastewater Purification System

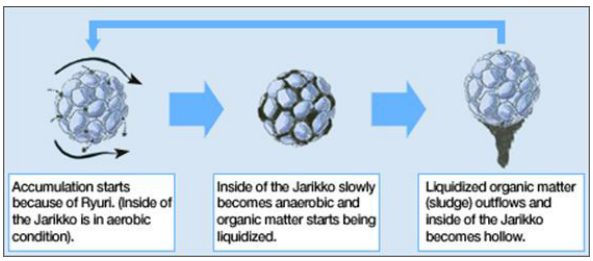
COMPANY
Aquatech, Ltd.
www.aquatech.co.jp/eng/index.html

INTRODUCTION

The Jarikko (JRK) Wastewater Purification System performs using clumped crushed rocks, called Jarikkos, which are made of 2cm size gravels and bound together by resin, measuring 10cm in diameter. The JRK purification system is used to purify water bodies such as rivers and lakes, to treat industrial organic wastewater or to treat community wastewater plants. The types of pollution that can be cleansed by this system are organic carbohydrate substances or compounds, organic waste, sludge, etc. The system is innovative in that it does not need a sludge treatment due to the application of the Jarikkos.

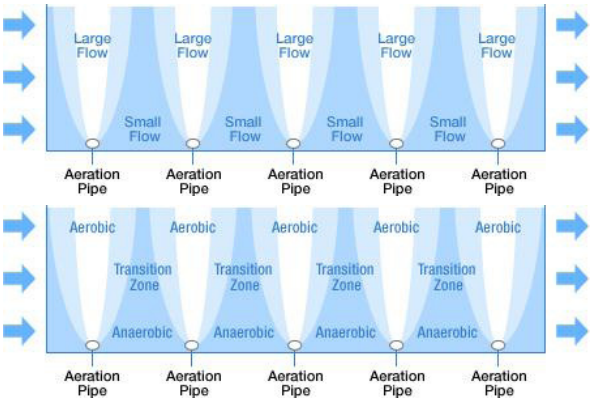
PROCESS

The solid organic matter that pollutes the specific water body accumulates inside of the Jarikko and a solid-liquid waste separation process begins. The liquid wastewater flows through the Jarikko and the solid organic matter remains within the Jarikko and liquidizes itself in a time span of 10 to 30 days due to anaerobic reducing conditions. Thereafter it flows out again by itself and in doing so makes room for the new solid organic waste matter to take its place within and thereby to undergo the same decomposing process within the Jarikko again. Hence, purified water and solid organic matters are separated, solids are confined in the Jarikko, and the water is thus purified. In measurements taken by the Company Aquatech, the polluted water is purified whereby BOD (mg/l) is reduced by 80-90%.



Jarikkos are piled-up or banked-up in containers or tank vessels. Wastewater enters into these mediums and flows through the Jarikkos. Conventional activated Sludge Methods and Contact Oxidation Methods have the space ratio of 95-100%. Therefore, a reaction tank is always in the equal environment of aerobic condition. The space ratio between Jarikkos is 40% and aeration pipes are placed 40cm apart. Therefore, the flow above and between aeration pipes is differentiated into a small and a large flow. Moreover, the surface and the inside

of the Jarikko have a different flow rate, and therefore, many different environments can be created. Solid organic wastes need anaerobic conditions in order to be liquefied. The separation of large and small flows of water can create anaerobic areas within the tank that lead to the creation of anaerobic bacteria which in turn liquefies solid organic waste.

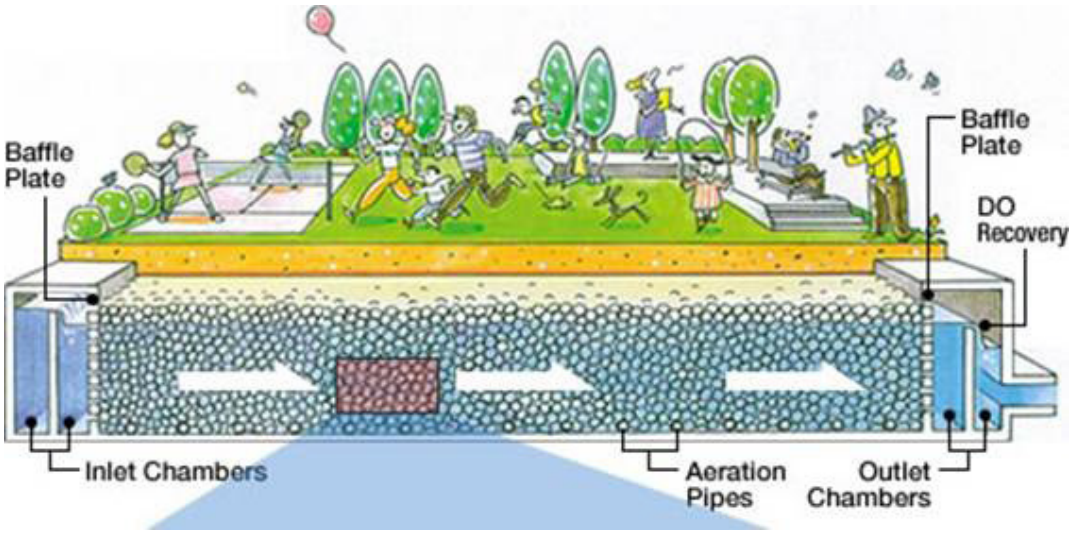


COMPETITIVE ADVANTAGE

The operational and construction costs are comparatively lower than technologies that use the activated sludge method to purify wastewater. The material costs of Jarikkos are inexpensive as they are simply made of gravel and are maintenance free. No major infrastructure investments are necessary as in the case of ordinary solid waste treatment plants.

The illustration below shows the advantage of this technology in that the installation of the Jarikko technology underneath a park or recreation area where wastewater flows, or could flow, people will be able to enjoy their activities in a safe environment and will not be affected by any chemical treatments or toxic cleansers, which would alternatively be employed by other technologies to combat such problems. In most applications to date, Jarikkos are used near river bodies where contaminated water is drawn into the Jarikkos and purified water flows back into the rivers.

Contact information
Mr. Yoshitaka Fujii
aqua@aquatech.co.jp
+81-42-628-7373



Energy-related green industries

TECHNOLOGY
Gasification Power Generation

COMPANY
Kinsei Sangyo Co., Ltd.
www.kinsei-s.co.jp/index2.htm

INTRODUCTION

The Kinsei Sangyo Company Gasification Power Generation technology converts waste to useful energy resources through a specific incineration process that uses a dry distillation gasification combustion system.

PROCESS

The waste that is fed into the incinerator does not need pre-treatment. The technology is comprised of a dry distillation gasification furnace that gasifies the wastes. The second element of the technology is the main furnace where perfect combustion takes place that mixes the dry distilled gas that is generated in the afore explained furnace and air. This generates a spiral flow system that prevents carbon generation from the flames and hence delays combustion. There is a reduced generation of dioxins throughout this process with a retention time within the furnace of over 2 seconds with a temperature exceeding 900 degrees Celsius.

The third element of the technology, and which is optional, is the cooling tower and waste heat boiler. The function here is to cool the high temperature gas from the main furnace. The added value here is that steam pressure can be generated here that can be connected to heat a water boiler. Additional elements are the numerous options and the adaptability of the system for the utilization of the heat that is generated in this process. For example the heat generated can be used to dry garbage, to dry sludge, to ferment sludge, to heat a hot water pool, as energy for a production factory, and many more.

As an example, a plant is able to process 100 tons per day of municipal waste. In the case of medical waste, the plant would be able to process approximately 30 tons per day. A smaller plant is able to process one ton of waste per day. This type of plant

has the added advantages that it can be installed within one day.

COMPETITIVE ADVANTAGE

Controlled gasification, clean and safe, economic benefits, construction permits already available in many countries, almost no auxiliary fuel required, recycling of rare metals, high efficiency of heat recovery and automated operation. In terms of pollution reduction, the dust volume of the dry distillation gasification combustion is rather little in comparison to direct combustion incineration technologies. Less ash is generated as well.

The separation of the gasification zone and the combustion zone within the technology allows for the waste heat utilization with waste water boilers and drying equipments, as well as in the applications to be used as recovery equipment.

Contact information
Mr. Keiichi Kaneko
kkaneko@kinsei-s.co.jp
+81-27-346-2161

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Telephone: +43 (0) 1 26026-0, Fax: +43 (0) 1 26926-69
Email: h.leuenberger@unido.org, Internet: www.unido.org

GREEN INDUSTRY