

## New Environment-Related Technology and Products

### CFC-free heat pump systems complying with multiple fuels

At Kubota, we are developing heat pump systems capable of supplying heat in a broad range of temperatures, for freezing, cooling, heating, and hot water, using gas engines that complying with multiple fuels, and gas cycle units using helium as the working gas.

Utilizing, mixed gas (CO + H<sub>2</sub>) supplied from a broad energy network, the system four types of cooling and heating (-10°C, 7°C, 45°C, 80°C) in a single system.



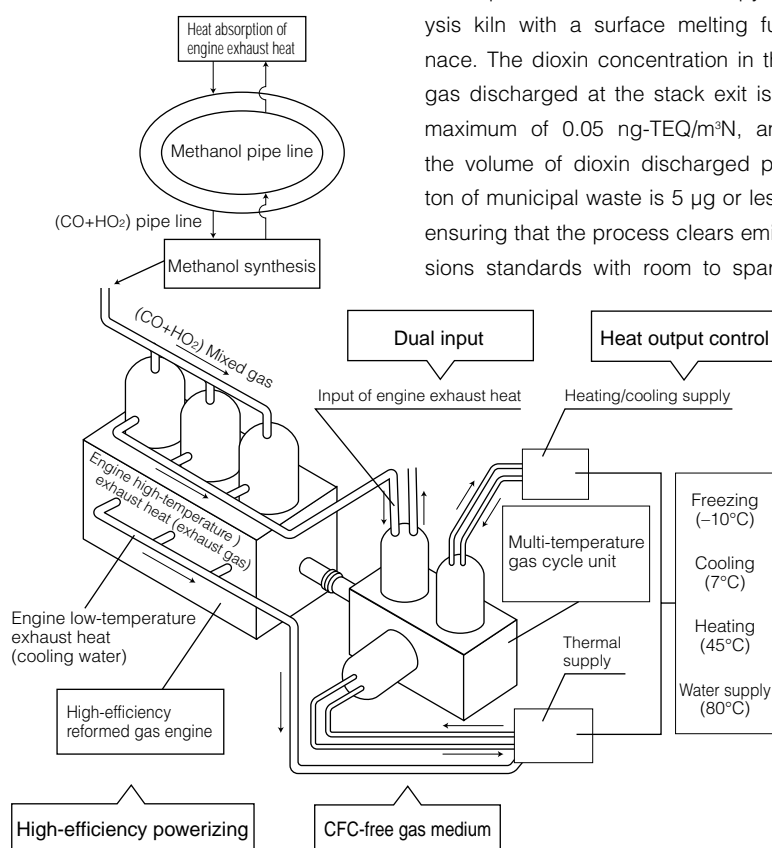
Pyrolysis melting furnace

### Dioxin-reducing pyrolysis melting furnace

The pyrolysis melting furnace holds out high expectations as a next-generation garbage incinerator capable of reducing the burden placed on the environment by society's need to dispose of increasingly large volumes of waste. Currently, a process is under development which combines a pyrolysis kiln with a surface melting furnace. The dioxin concentration in the gas discharged at the stack exit is a maximum of 0.05 ng-TEQ/m<sup>3</sup>N, and the volume of dioxin discharged per ton of municipal waste is 5 µg or less, ensuring that the process clears emissions standards with room to spare.

The melted slag satisfies environmental standards for soil, and can be recycled for use in roadbeds. In addition, no supplementary fuel is used; melting can be done using only the energy inherent in the waste itself, thus achieving a low-energy process that may well eliminate many of the problems involved in the intermediate processing used in conventional urban municipal waste disposal.

### Schematic configuration of the system



### Analysis of Endocrine disrupting chemicals and product development using that technology

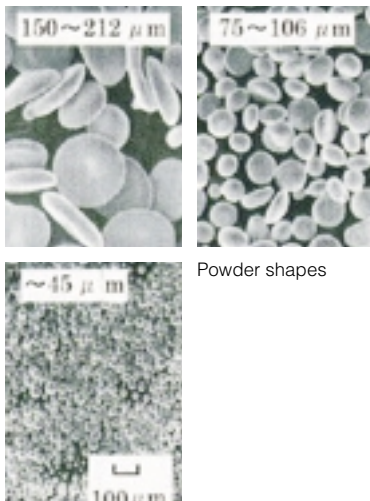
The safety of chemical compounds has recently received increasing attention. Especially the correlation between concentration and affection to human health of Endocrine disrupting chemicals is now studied.

We are using analysis, such as gas chromatography mass spectrometry and liquid chromatography mass spectrometry, to quantify the concentrations of chemical compounds at extremely minute levels such as µg/L ng/L. We are also using bioassay methods to estimate affection to living organisms.

We are working to develop products that assure greater safety than ever before with using these technologies.

**Amorphous soft-magnetic powder for magnetic cores**

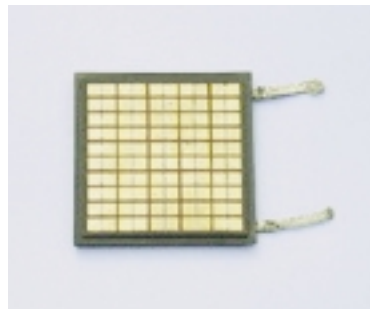
Amorphous soft-magnetic powder, manufactured using the SWAP (Spinning Water Atomization Process) method, can be used as material for dust cores. These cores, which, as dust cores, have relatively high magnetic permeability and saturation magnetic flux density, can be used at high frequencies of up to 1 MHz with a low rate of loss. Furthermore, even with superimposed current, there is little decrease in magnetic permeability, and the temperature characteristic is outstanding, meaning that these cores will likely make a significant contribution to lower-energy, more compact power factor correction circuits for power supplies and PAM control circuits for inverters. Kubota is starting sales of amorphous soft-magnetic powder to the market as a material for these cores.



Powder shapes

**Developing thermoelectric module and generators**

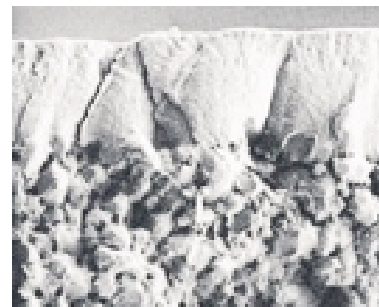
In order to make more effective use of energy in the low temperature ranges, which is currently discarded without being used, Kubota is developing thermoelectric module and generators. These are used to convert energy directly from thermal energy to electrical energy, and offer numerous advantages in that they are highly reliable, free of noise and vibration, and emit no substances harmful to the environment. One possible application might be producing electricity from automotive exhaust gases and the heat discharged from waste incinerators.



Thermal power generating module

**Ceramic membrane produced by nano-control technology**

From the standpoint of energy conservation and measures to combat global warming, there is a strong need worldwide for a gas permeation membrane. With this in mind, Kubota is focusing particular attention on developing a permeable membrane to filter out CO<sub>2</sub>, which plays an especially large part in global warming. By controlling small-pore diameters on the nanometer order, improving membrane surfaces even further, and allowing only CO<sub>2</sub> to adhere to the surface, we have succeeded in developing a ceramic CO<sub>2</sub> permeable membrane coated with a silica-based thin film, using sol-gel on the outer surface of an alumina tube, thus providing a permeable membrane performance with a permeability coefficient ratio of 200 or better (at room temperature) for CO<sub>2</sub>/N<sub>2</sub>. This technology can also be expanded to other applications such as hydrogen permeable membranes.



Cross-section construction of the membrane for CO<sub>2</sub> separation

**Kubota centrifugal cast cracking tube MERT (Mixing Element Radiant Tube)**

“MERT” is a centrifugal cast cracking tube with a spiral element on the inside surface, and suggests new concept of cracking tube for improving steam cracking process.

In an ethylene pyrolysis furnace, feed gas typically naphtha or ethane and steam gas, flows inside of the cracking tube at high velocity and is heated at high temperature from the outside of the tube, and then it is thermally cracked into olefin such as ethylene, propylene and so on.

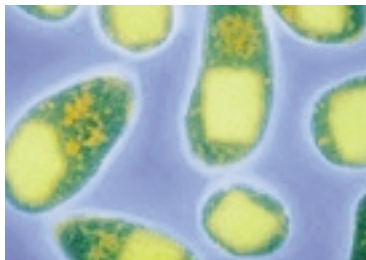
The “MERT” spiral element promotes turbulent flow which breaks boundary film and allows better mixing of the fluids inside of the tube. Thus the feed gas inside of the “MERT” tube is ① heated uniformly, and ② heated efficiently. This enables heating furnaces to be run with less energy, with a longer service life for the tube because of the lower tube metal temperature, with a longer run length because of less coking, with increased capacities, and with increased olefin yield.



Kubota centrifugal cast radiant tube

**Bio-pesticides**

To establish the field of biotechnology, Kubota is developing new microbial pesticides with increased residual activity and insecticidal properties. Based on natural products found in the environment, these new pesticides produce less environmental pollutants with almost no insecticidal resistance to different insect species. Kubota is the first manufacturer to pioneer large scale fermentation technology for producing insect parasitic nematodes in Japan, which are a natural enemy for harmful insects. Kubota is now working hard to get these products on the market where they can be useful and productive to our communities.



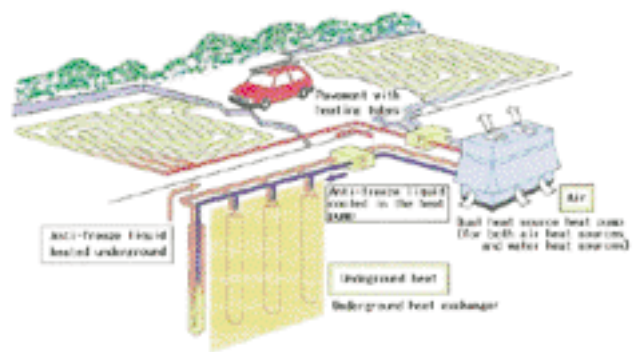
Bio-pesticide

**Energy-conserving, non-sprinkling snow-melting systems**

Snow, a constant plague in wintery regions, can be melted using natural energy, such as the heat produced deep within the earth, or the warmth of the air. At Kubota, we are enhancing these natural forms of energy by developing our own proprietary heat pump designed especially for snow melting.

Our system uses far less energy than heating-wire systems, and enables the volume of CO<sub>2</sub> produced indirectly by the system to be suppressed to minimum levels. In addition to underground heat and atmospheric heat, the heat from groundwater sources and from heat discharged in urban areas, such as from wastewater, is being put to effective use to serve mankind in better ways.

**Conceptual diagram of the non-sprinkling snow-melting system using underground heat**

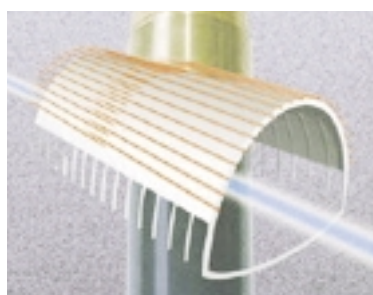


**Developing safer materials for use in tunnel floors**

**(Hightom)**

As a supplementary material for tunnel excavation, Kubota has developed propulsion pipes, insert pipes, hoses, and valves using recycled materials from hard vinyl chloride pipes.

Propulsion pipes and insert pipes are embedded by being punched deep into the tunnel walls, where they function as semi-permanent supplementary supports. The distribution of hard vinyl chloride pipes varies from one manufacturer to another, but this material only needs to serve a temporary function, and various types of hard vinyl chloride pipes can be used in combination. Additionally, fewer outbreaks are required than when only steel pipes are used, as in conventional tunnel excavation.



**Kubota pipe-style breakwater seepage wall**

With the 21st century just around the corner, more and more marine infrastructures such as harbors, fishing ports, and cultivation beds are being built, and measures to assure water quality, such as fishing areas closed off by breakwaters, are being closely scrutinized. At Kubota, we put our ductile cast iron pipes, with their outstanding corrosion resistance and durability, to work in the field of seawater purification. Kubota pipe-style breakwater seepage walls not only keep the sea at bay, but enable aerated seawater to enter harbors and ports, helping to keep the water clean and healthy for living organisms. Our products are already hard at work in 25 harbors and ports all over Japan.



Kubota pipe-style breakwater seepage wall

**“Super” garbage power-generating system**

Conventional power plants have tended to lack efficiency. To solve this problem, Kubota introduced the “Super Garbage Power-Generating System”. In this system, hot exhaust gases from gas turbines are used to heat steam to high temperatures, significantly boosting the volume of power generated. In addition, we’ve also developed a “Super Fire System” that heats steam directly with a burner, producing the same high temperatures as those available with thermal electric power plants. These and other Kubota technologies are helping to prevent global warming and contributing to a healthier environment.

We also use computer control and technology that eliminates hazardous gases, to help de-toxify the gases emitted from furnaces.



Clean Center East Plant No. 2, Sakai City (460 t/day)