

Efficient power generation using middle- and low-temperature waste heat (at approximately 100°C or below).

# Kalina Cycle Generating System

## Features

- The world's first Kalina Cycle power generating system put to practical use.
- Power generation that uses middle- and low-temperature waste heat at a maximum of 100°C.
- Reduction effects of 6,600 kL of crude oil and 17,000 tons of CO<sub>2</sub> per year with a power of 3,500 kW generated.

## Overview

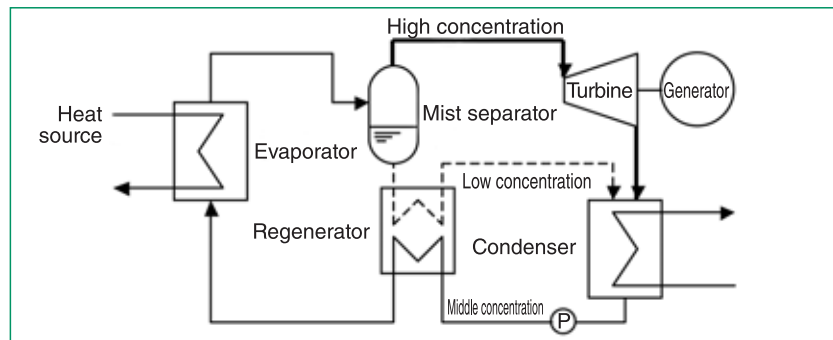
(Technical principles, actions, etc.)

Kalina Cycle is a thermodynamic cycle invented by Dr. Alexander Kalina, a Russian engineer, in the USA in 1980. Kalina Cycle uses a binary working fluid of an ammonia-water mixture to drive a turbine generator. Sumitomo Metal constructed a power generating system to which Kalina Cycle is applied in order to make use of hot wastewater discharged from the cooling stage for a converter gas duct in Sumitomo Metal's Kashima #2 steel-making plant. Heat of this hot wastewater had not been recovered.

Kalina Cycle utilizes the feature of an ammonia-water mixture, i.e., the condensation pressure of the mixture changes according to its mixture ratio and non-isothermal evaporation and condensation characteristics. The mixture is heated in an evaporator by the waste heat and converted into the state of mist. Then a mist separator is used to separate the mist into high-concentration ammonia vapor and low-concentration ammonia solution. A turbine is driven by the high-concentration ammonia vapor to generate power. Then the ammonia vapor is absorbed to the low-concentration ammonia solution and condensed. The cycle is closed by raising the pressure of the ammonia solution with a pump and returning the solution to the evaporator. Sumitomo Metal's Kashima Steel Works utilizes waste hot water at 98°C discharged from the cooling stage for the converter gas duct as heat source.



Kalina Cycle



System Configuration of Kalina Cycle Generation

## Supply List

- **Kashima Steel Works, Nippon Steel & Sumitomo Metal Corporation**

## Effects

- ◎ **The Kalina Cycle generating system of Sumitomo Metal's Kashima Steel Works came into operation in August 1999. Presently, the power generation of the system amounts to 3,500 kW by using 1,300 tons of hot wastewater at a temperature of 98°C from a converter, which has brought reduction effects of 6,600 kL of crude oil and 17,000 tons of CO<sub>2</sub> per year. Furthermore, the system is the world's first actualization of the technology to convert thermal exhaust, which had not been used effectively in the past, into electric power as easy-to-use energy. The practical use of the system demonstrated that the system is an additional effective measure to prevent global warming.**

**Nippon Steel & Sumitomo Metal Corporation** Energy Engineering Department 2-6-1 Marunouchi, Chiyoda-ku, Tokyo 100-8071

● TEL / +81-3-6867-6662 ● FAX / +81-3-6867-4928 ● <http://www.nssmc.com/>