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### **Activities of Kawasaki Heavy Industries for Realization of International Hydrogen Supply Chain**

Terukuni Toge

Project Group, Hydrogen Strategy Division, Kawasaki Heavy Industries, Ltd.

In order to achieve a "Carbon-Free Society" where society as a whole will reduce greenhouse-gas emissions to reach zero net carbon emission by 2050, the use of renewable energy as alternatives to fossil fuels is required. However, renewable energy has issues that it requires a bigger resource input and physical footprint than fossil energy due to its low power density, and that a stable power supply is not likely to be expected due to the meteorological effect. Hence, expectation and interest in hydrogen energy are increasing as the last resort.

Kawasaki Heavy Industries (hereafter KHI) is the only company that owns a series of core technology regarding hydrogen production, transportation, storage, and utilization. KHI has been developing technologies to produce hydrogen from untapped resources overseas and transport it to final destination, Japan. In the field of hydrogen transportation and storage, KHI built not only the largest liquefied hydrogen storage tank in Japan at Kobe LH2 Terminal (Hy touch Kobe) but also the world's first liquefied hydrogen carrier "SUISO FRONTIER". On February 2022, KHI succeeded in the world's first maritime transport demonstration of liquefied hydrogen from Australia to Japan, which is produced from untapped brown coal in Latrobe Valley of Victoria, Australia. As for hydrogen utilization, KHI installed cogeneration facility with 1 MW gas turbine as the core, which is fueled by hydrogen and natural gas, in Kobe Port Island, and succeeded in the world's first delivery of both energy and heat in an urban area generated using a gas turbine fueled by 100% hydrogen on April 2018.

Based on the findings from those demonstration tests, KHI will develop technologies for large-scale hydrogen production, and plans to conduct commercial demonstration in Late 2020s to realize a full-scale commercialization in 2030.

### **Introduction of Carbon Neutral Technology to Improve of Power Generation Facility for Pulp and Paper Mills**

Naoto Hasegawa

Mitsubishi Heavy Industries, Ltd.

MHI Group has set the target of achieving Carbon Neutrality by 2040 and is aiming to abate discharging of carbon dioxide (CO<sub>2</sub>) emissions from its own operations by 2040. As an interim step and in line with MHI's commitment to addressing climate change, CO<sub>2</sub> emissions from its own business activities will be cut in half by 2030 (compared to 2014).

This paper includes two topics for achieving carbon neutrality. One is the status of development for hydrogen firing technology (for gas turbine and engine) and ammonia firing technology (for gas turbine, diesel engine and boiler). The other is the introduction of Takasago Hydrogen Park. In the Takasago Hydrogen Park, the hydrogen production and storage equipment are under installing work next to existing GTCC demonstration plant at Takasago Machinery Works, Hyogo, Japan. This will enable validation testing of an integrated progress from next-generation hydrogen production technology to power generation utilizing hydrogen fired gas turbines. After validating the system utilizing water electrolyzation, MHI plan to produce turquoise hydrogen by pyrolyzing methane into hydrogen and solid carbon.

In addition, we, MHI, can support to create the roadmap achieving Carbon Neutrality for pulp and paper mills, with making alignment with Clients. Based on the Client's roadmap, we can also contribute to supply the "Sustainable" system.

## **State-of-the-art Integration of Energy Balance by Andritz -A Futuristic Pulp Mill with Integration of Fiberline and Recovery Processes-**

Tsukasa Katayama, Ryo Yoshida and Masato Tsuchitana  
Andritz K.K.

Energy conservation and the use of creative energy sources that do not use fossil fuels are the most important and urgent issues for reducing CO<sub>2</sub> emissions and preventing global warming. In kraft pulp mills, 50% of the biomass supplied is used as green energy, making it an environmentally friendly process. However, there is still much room for improvement. By integrating and optimizing production lines consisting of individual processes, energy conservation and energy creation are possible.

Pulp production line operations require hot water and steam as chemical and thermal energy. These are supplied by the recovery process. The recovery process also has the important function of generating electricity and supplying power to the entire mill system. If the amount of steam used in the system can be reduced, more electricity can be generated, leading to lower costs and higher profitability. ANDRITZ is improving energy efficiency by integrating and optimizing the pulp production line and the recovery process, and is implementing processes that will enable closed systems.

### **Start up Experience of a Biomass boiler**

Kazuto Taguchi  
Tonegawa Division Paper Mills Rengo Co., Ltd.

Because of increasing awareness about environmental issues and soaring fuels price, Tonegawa plant, Rengo, has installed a new biomass boiler that uses three kinds of fuels, such as wood chips, RPF and waste tire. The capacity of new boiler is determined the same level as existing gas boiler and we decided to use existing one for standby.

After we started up the new boiler, we have faced many new problems. For example, ①switching work of high pressure steam line from existing boiler to new boiler, ②accumulating metal sludge in the bed caused by wire of waste tire. However, we were finally able to solve these problems by reviewing operation methods and starting to check quality of fuels frequently. Although we are operating the new boiler stable now, we still have 2 issues, such as outflow problem of sand from the bed and determining a continuous operating period in the future. On the other hand, CO<sub>2</sub> emission has been decreased by increasing utilization rate of the new boiler. Therefore, we predict we will be able to achieve the target, reducing 90,000 tons-CO<sub>2</sub>/year, as original plan.

### **The Activities for Energy Saving in Ohe Mill**

Shoya Ishikawa  
Ohe Mill, Marusumi Paper Co., Ltd

Various climate changes such as global average temperature rise and sea level rise are occurring, and as interest in environmental issues is increasing day by day, the reduction of greenhouse gas emissions has become one of the important global issues.

In order to realize the "2050 carbon neutral" declared by the government in the fall of 2020, the "Shikoku Chuo City Carbon Neutral Council" was established in Shikoku Chuo City, where the Ohe Mill Marusumi Paper Co., Ltd. is located. We are promoting various measures based on the recognition that it is necessary to work on the use of new fuels and the recovery of CO<sub>2</sub>.

In addition, the Energy Conservation Law also requires a reduction in energy consumption per unit by an average of 1% or more per year, and due to the impact of soaring raw material and fuel prices and the appreciation of the yen, energy conservation activities are not only aimed at reducing CO<sub>2</sub> emissions, but also reducing production costs. It is an activity that must be tackled from all aspects.

This paper introduces the energy-saving activities of the Ohe Plant, which replaces the cooling steam of the oil gun for combustion support of the fluidized bed boiler with combustion air.

## **Activities for Energy Saving in Takaoka Mill**

Satoshi Masugi  
Takaoka Mill Chuetsu Pulp & Paper Co.Ltd

The paper industry is an energy-intensive industry, and energy saving activities are an effective means for environmental issues and cost reduction.

Our factory has made efforts for energy saving activities throughout the factory and has achieved goals.

However, with the progress of activities, effective projects are decreasing and in recent years it has been difficult to achieve more energy saving targets.

In order to acquire energy saving benefits at this factory, we are working to raise employee's awareness of energy conservation and find out new projects, mainly by members of energy conservation management committee.

Here, we introduce examples that our factory has implemented.

## **Challenges of Energy Saving in Kasugai Mill**

Shota Oi  
Kasugai Mill,Oji Paper Co.,Ltd

Kasugai mill is working on the environmental objectives for ISO14001, such as promoting energy conservation, reducing waste and use of sustainable resources, recycling of used paper.

In order to enable achievement of that, we set a goal 『Total primary energy reduced by 1.5% year on year』 and challenge together. This report introduces several examples of energy savings regarding lime Kiln in Recausticizing process and also CFB (biomass boiler) plant.

## **Andritz proposal for CO<sub>2</sub> reduction at pulp mill - Sootblower ACE for recovery boiler-**

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As of and after the summer of 2022, Japanese pulp & paper mills are likely to be in a very difficult situation in terms of energy-related matters. Challenges include meeting the CO<sub>2</sub> emission limitation targets set out at COP26, strong demands from customers to reduce coal usage for the mills, rapidly rising fossil fuel costs (coal, crude oil, natural gas), and rapidly soaring raw material costs due to unstable international conditions and the weaker Japanese yen. Japanese P&P mills are required to take strict measures to reduce energy and cost, based on the situation of their factories. We will introduce some of ANDRITZ's technologies that can respond to the customers' situation. In addition, we will introduce the Sootblowing ACE, a technology unique to ANDRITZ, to the sootblower used in recovery boilers as an IT technology.

## Valmet Technology for Energy Saving and Reducing CO<sub>2</sub> Emissions in Pulp Mills

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Pulp & Energy, Services business Line, Valmet K.K.

In the industrial sector, including the pulp and paper industry, energy saving and reduction of CO<sub>2</sub> emissions, including conversion to renewable fuel from fossil fuels, are the most significant challenges for sustainable development in the future. In the pulp and paper industry in Japan, energy saving of pulp and paper mills is explored to meet the 2030 CO<sub>2</sub> emissions reduction target. Valmet has a comprehensive global sustainability business and is developing technologies to reduce CO<sub>2</sub> emissions in the use phase of Valmet's technologies.

The introduction of the Valmet ImpBin™ - atmospheric pressure impregnation vessel- and the conversion of an existing 1-vessel digester to a Valmet OptiCook™ are typical examples of energy saving in pulp mills.

Both modifications enable to achieve high yield cooking by allowing sufficient chemical impregnation into inside of chips at low temperatures and long impregnation time, and to reduce steam consumption by lowering the cooking temperature.

Another example of energy saving in the washing stage is the introduction of DiConn™ with a pressure diffuser (PD) at digester blow line and Valmet TwinRoll Press Evolution™ press washing machine at brown washing stage. The former results in washing at higher temperatures in the PD, which increases the temperature of the C8 extraction liquor as well as washing efficiency, leading to a increase of steam generation in the flash cyclones. The latter is installed in the final stage of the unbleached washing stage to reduce the amount of washing liquor used while improving or maintaining washing efficiency, and to reduce the amount of black liquor sent to the evaporator, which results in a reduction in steam consumption at evaporation process.

The lignin recovery and the methanol recovery facilities from pulping process provided by Valmet have the potential to produce fuel and generate new revenue sources for the mill.

The lignin recovered in the former is expected to become a new source of revenue for mills through the development of new applications or can be used as biofuel at a lime kiln. In the latter, liquid methanol with low NO<sub>x</sub> and SO<sub>x</sub> content can be refined and is expected to be used for raw material or fuel and marketing purposes.

### Revision of the JIS P 8150

#### Paper and board - Determination of color by diffuse reflectance - Indoor daylight conditions (C/2°)

JAPAN TAPPI, Pulp and Paper Testing Standards Committee

JIS P 8150 Paper and board — Determination of color by diffuse reflectance — Indoor daylight conditions (C/2°) specify a procedure for measuring the color of paper and board by a reflectometer. This standard has been revised to the second edition for harmonization towards ISO 5631-1 standard. Harmonization with corresponding ISO standards is intended to avoid confusion over test methods and facilitate trade. This second edition cancels and replaces the first edition published in 2004.

The main changes of this edition are as follows:

- 'Indoor daylight conditions' has been added to the title.
- Equipment calibration procedure measuring test pieces containing fluorescent whitening agents have been detailed.
- Weighting functions for obtaining tristimulus values using an abridged spectrophotometer with bandpass correction, have been added.
- The units for reading values have been changed from 0.05unit to 0.01unit, and JIS Z 8401 about rounding of numbers has been deleted.
- Editorial and other changes have been made to first edition.