

The paper industry in Japan has grown with help from various auxiliary technologies. One of them is technology for energy saving. Japan Paper Association publishes the energy consumption of the industry every year. Japan TAPPI made surveys on unit energy consumptions of main equipments in 1977, 1988 and 1999. Though it is not easy to compare the efficiency of energy consumption because of different production lines, those data suggest that the Japanese paper industry has been really efficient in energy saving..

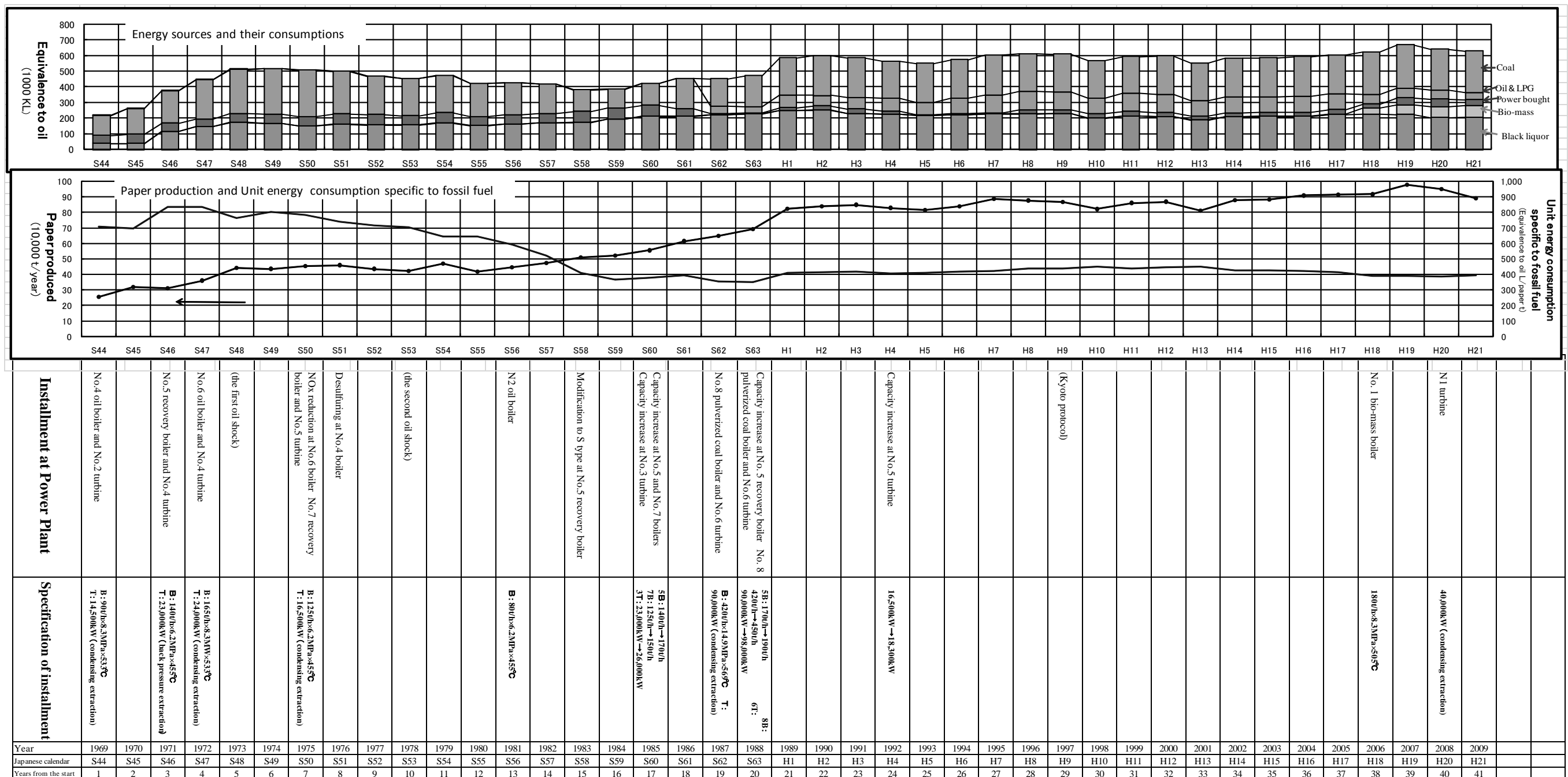
As represented by the two oil shocks, the circumstance of energy supply in Japan has been radically changing. So, it is worth knowing, as a history of technological development in energy conservation, how a mill has coped with those changes. Understanding it, the management of Ishinomaki Mill of Nippon Paper Industries Co., Ltd. courteously made the data of its power plant operation during 40 years open to public. Though it is an example of one mill, which is one of the largest pulp

and paper mills in Japan, it shows not only the general trend of the industry but also the actions it took during 40 years. We believe that the data will help develop the technologies in that sector in the future.

1. Energy sources and technologies of using them

After the World War II, the paper industry used coal mined in Japan for its boilers. Then oil got commonly used in replace to coal since the 1960s. After the two oil shocks in 1973 and 1978, IEA (International Energy Agency) banned installing new power plants using oil. The mill was forced to use coal for its power plant in 1987.

Then, the global warming became concerned, and Kyoto protocol was agreed in 1997 and got in effect in 2005. The mill, already shifted from oil to coal since 1987, started to use biomass fuel in 2006 and is working to reduce its carbon dioxide emission.



(1) Technology for fossil fuel

At the beginning, boiler was a stoker type which burned domestic coal. Then oil boiler of high efficiency replaced it. After the oil shocks, the mill was forced to use coal, and the boiler installed burned pulverized coal. Compared with the old stoker type, it had high burning efficiency, reduced heat loss due to exhaust gas and was as effective as oil boiler. It could be big and one installed in 1987 was 420t/h.

(2) Technology for non-fossil fuel

The pulp and paper industry has been using black liquor, which is a by-product in chemical pulp production and contains organic matters dissolved from wood during pulping. It is well known as a kind of reproducible biomass energy. The mill gets 30 % of its total energy supply from black liquor. Recently, aiming to reduce carbon dioxide emission, the biomass boiler was installed in the mill, a type of which is fluidized bed with recirculation. It is burning construction waste, which is regarded as reproducible energy, and RPF which is a pellet made of combustible waste.

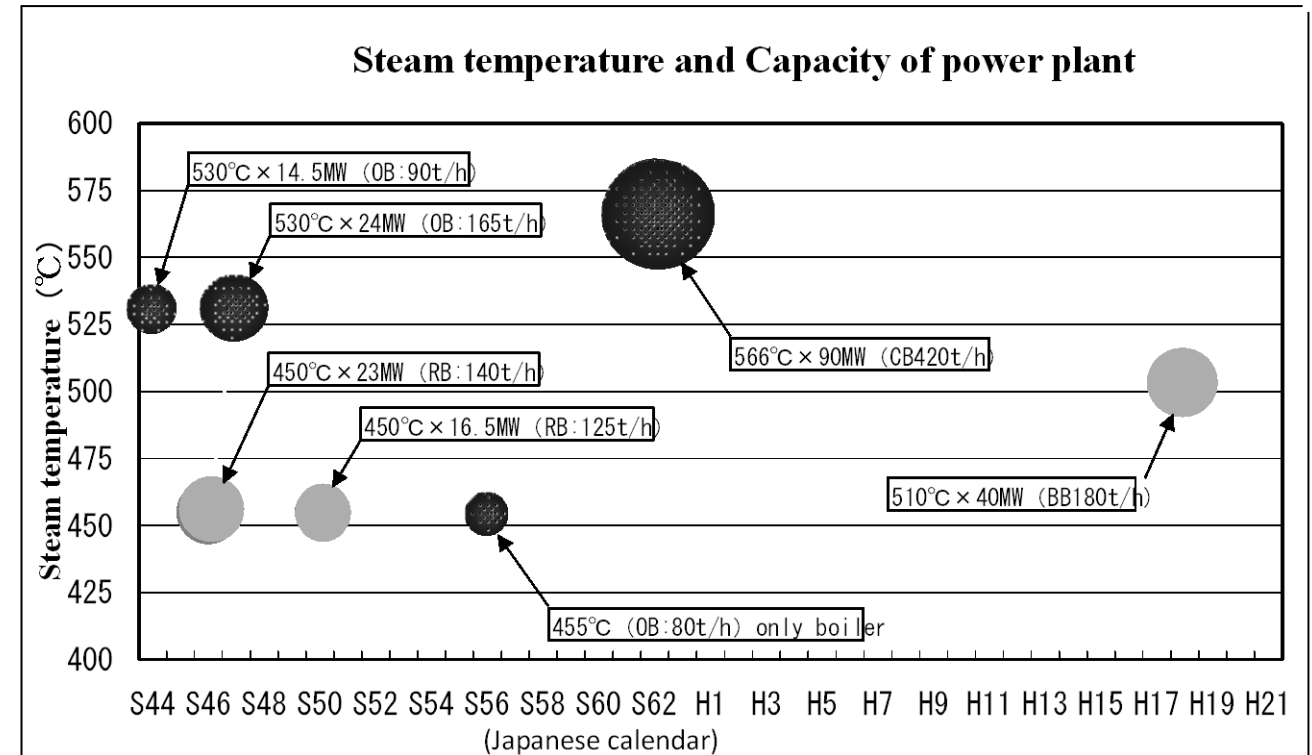
2. Technologies of improving turbine efficiency

(1) Improving steam quality

It is known that operating turbine at high temperature under high pressure is good to thermal efficiency, and the mill has been working to improve it. To operate at high temperature under high pressure, various kinds of technologies have been needed such as development of materials which could be used under sever conditions and maintenance technologies like nondestructive testing and life prediction. In the early 1960s, steam turbine of 566 °C for power companies was developed, and it became available in industrial use in the early 1980s. The mill installed one (566 °C-90MW) in 1987. Regarding recovery boilers and biomass boilers, they are operated at lower temperatures to prevent corrosion at boiler tubes

(2) Co-generation system

As papermaking needs lots of power and steam for drying paper, co-generation system has been used since old days in pulp and paper industry. As seen in the chronicle table, the mill already had a condensing extraction turbine in 1969. The



co-generation system in the mill works efficiently in a way where steam of high temperature and pressure is fed to turbine and part of it is extracted and used for drying paper after power generation. The types of turbines are back pressure turbine, back pressure extraction turbine and condensing extraction turbine.

(Data presented by: Ishinomaki Mill, Nippon Paper Industries Co., Ltd.)

Complement

Energy Committee of JAPAN TAPPI made surveys on energy consumption in the industry in 1977, 1988 and 1999. It sent a questionnaire to every mill in Japan and received answers from them. In 1999 survey, 90 mills answered that covered 84 % of the paper and paperboard production volume in Japan. The questionnaire asked unit energy consumption at each unit operation such as pulping, papermaking, utility and so on, along with energy sources the mill used. The results were published in JAPAN TAPPI Journal⁽¹⁻³⁾.

The energy consumption was fairly saved in ten years from the first survey of 1977 to the second survey of 1988. But in the following ten years, reductions in unit energy consumptions of main equipments were small and in some cases unit energy consumptions increased due to new modifications aiming to improve paper quality.

The same trend is observed in the unit energy consumption specific to fossil fuel of Ishinomaki Mill. It kept going down until the 1980s and then slightly went up in the next ten years. The government asks further energy saving to industries. But, there is not found an answer for satisfying its request yet.

(Kiyooki Iida)

(1) JAPAN TAPPI Journal Vol. 33, No. 1, p.110 (1979)

(3) JAPAN TAPPI Journal Vol.44, No.3, p.327, Vol.44, No.4, p.447, Vol.44, No.7, P.787, and Vol.44, No.8, p.891

(2) JAPAN TAPPI Journal Vol.55, No.5, p.573 and Vol.55, No.6, p.737 (2002)

Unit energy consumptions of paper and paperboard machines

	Steam (t/t)				Power (kWh/t)			
	1999	1988	1977	1967	1999	1988	1977	1967
Newsprint machine								
Without size press		1.77	3.00	3.71		519	600	520
With size press	1.89	2.08			648	559		
Average	1.89	1.83	3.00	3.71	648	533	600	520
Kraft liner machine	1.27	1.85	3.30	4.64	375	470	650	520
Jute liner machine	1.39	1.80	3.00	4.64	416	470	630	660

Unit energy consumptions of pulping operations

	Steam (t/t)			Power (kWh/t)		
	1999	1988	1977	1999	1988	1977
LKP(before bleaching)						
Cooking	0.57	0.68		148	116	
Recovery	1.27	1.36		68	85	
Total	1.84	2.04	3.60	216	201	300
TMP	0.10	0.27		2,107	2,262	