Preserving and publicizing technological archives of Japanese paper industry
No. 27 Technologies that greatly influenced paper industry: Operational data of one newsprint machine during 47 years, JAPAN TAPPI (Oct.7, 2009)

1. Introduction

One newsprint paper machine was installed in 1960 in Japan that was one of the biggest sizes in the world at that time. Paper machines have got larger in their widths and have run far faster since that time, but that paper machine is still in operation as a machine of medium size of the present standard, is running at the efficiency of the highest level, and is producing newsprint rolls of the best quality. The operational data of that paper machine during 40 years, which showed how technologies were developed in newsprint production, are made open to public by the courtesy of the management of that mill.

The paper machine is No.6 newsprint machine in Kushiro mill, Nippon Paper Industries Co. When the machine was installed, it was evolutional in its design as described [1)]. The operational data were summarized from three view points: 1) history of modifications of the machine 2) history of its production efficiency 3) history of its product quality.

2. History of modifications of the machine

The Japanese paper industry historically modified and then ran old paper machines in parallel with installing up-to-date big machines to cope with steady demand increase. When they modified paper machines, they introduced innovative technologies at the time, improved productivity, refined product quality and were able to be competitive against imported products. This successive modification was a characteristic way of Japan to counter quickly against volatile needs of the market. It needed less investment than scrap and build which was a main way in the North Europe.

Table 1 presents a good example. The paper machine was frequently modified with up-to-date technologies. It also accepted developments in accessories like forming fabric, press felt and dryer fabric without delays. Please notice that pulp sources were also diversified and displaced by new ones like deinked pulp. In spite of those influential changes, the mil was running without loosing efficiency. The fact suggested that the mill has been flexibly managed in total.

The drive section of the machine was designed at 606 m/min. Its capacity was increased to 1200 m/min. by modification and the machine is running at 1050 m/min. at present.

Table 1 puts on record when new technologies were applied to the machine. At the same time, it represents the characteristics of the Japanese paper industry.

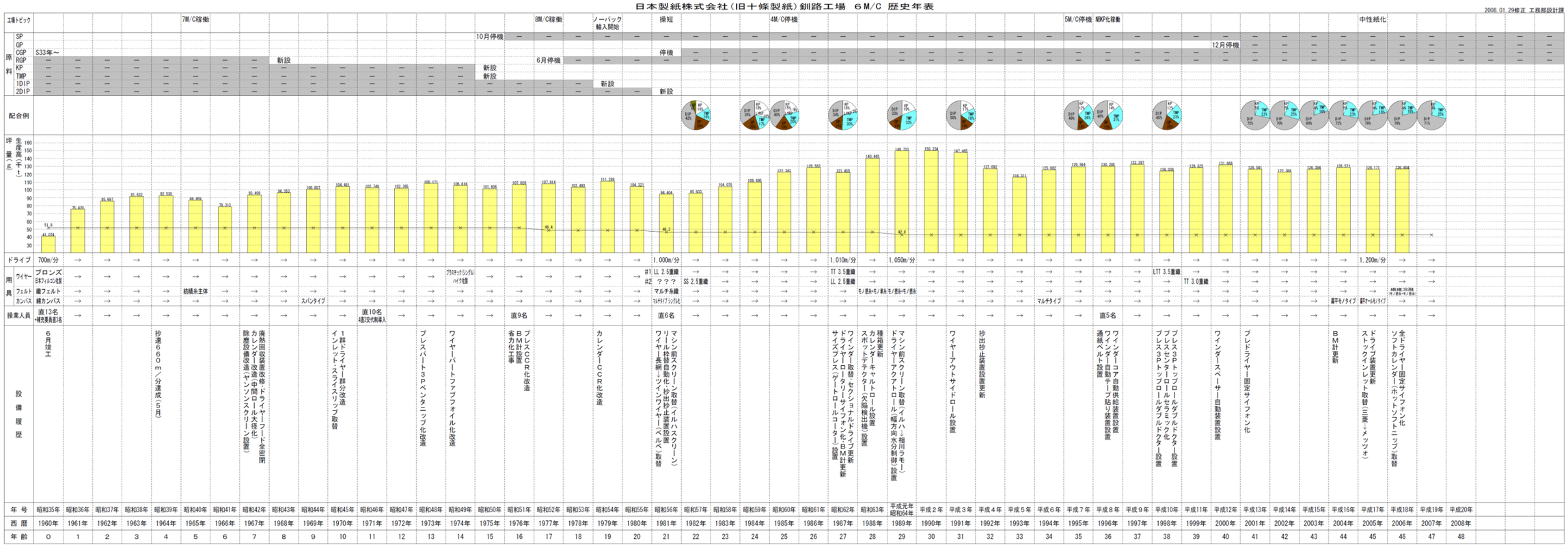
3. History of productivity

Fig. 1 follows the yearly newsprint output of the machine, and there was a drop from 1990. One reason for the decrease was that other products were produced along with newsprint and their volumes were not included. The other reason was demand for newsprint of less basis weight, and newsprint of lighter basis weight gave less tonnage at the same squire units than heavy newsprint. Therefore, it is reasonable to see the history of productivity in Fig. 2. . You see that the machine running speed increased gradually, jumped up at big modifications and then increased bit by bit. This gradual increase was achieved by continuous and steady developments in operational know-how, which is one of characteristics of Japanese mill management. Number of operators is also to be noticed (see Fig. 1). When the machine started, the number of operators was 48 in total, which consisted of 3 crews, 13 operators plus 3 assistants per crew. It was 20 operators in 2008 in total, 4 crews and 5 operators per crew. Introduction of mill automation like one in winder operation contributed this reduction, and it will be going on.

The overall efficiency of the machine is also noticeable in Fig. 2. The overall efficiency is a ratio of volume produced with acceptable quality against volume which should be produced in planned operating time. This ratio got over 90 % in three years after the start-up, and reached to 95 % in 1977. It has been said that paper machines in Japan run with high efficiency, but no proving data have ever been published. The data in Fig. 2 are a first case being made public, and it is highly appreciated that the data remain as an archive of paper machine operation in Japan.

4. History of product quality

The most influential factors in the history of newsprint production in Japan were to alternate pulp sources and to reduce basis weight. Product quality had to be satisfactory to requests by news printers which were also changing along with their technological developments. Table 1 shows how product quality has been controlled under those conditions.



As newsprint became less in its basis weight, sheet thickness, density and opacity decreased gradually. Recent sheet forming in neutral pH improved opacity significantly. Displacement to DIP increased sheet strength as DIP brought some kraft pulp in finished stock. As qualitative demands by news printers were changing, items measured for quality control were also diversifying. Why friction coefficient of the surface of newsprint was one of quality control items? It prevented slipping of printed news while being handled.

Sheet forming in neutral pH is a specific trial in Japan, and has improved opacity and brightness. Its future is very interesting.

How the performance of newsprint roll is evaluated in Japan? The most important is the frequency of sheet-breaks on printing press. It has little correlation to static sheet strength measured for quality control. The efforts of operating paper machines steadily without any defects in rolls, which can be achieved by accumulation of know-how in operations in a whole mill, are a very significant factor. Visual inspection of printed product is also very meaningful.

5. Acknowledgement

The copyright of the table and the figures belongs to Nippon Paper Industries Co. and no reproduction is allowed without its consent. This paper is quoted from the report by Kiyoaki Iida entitled “Survey on Technologies Developed in Newsprint Production in Japan” (March, 2008, National Museum of Nature and Science) under the permission of the organization.

Reference

1) Preserving and publicizing technological archives of Japanese paper industry No.6 (Oct. 13, 2004)

Fig. 2 History and Performance of One Newsprint Machine

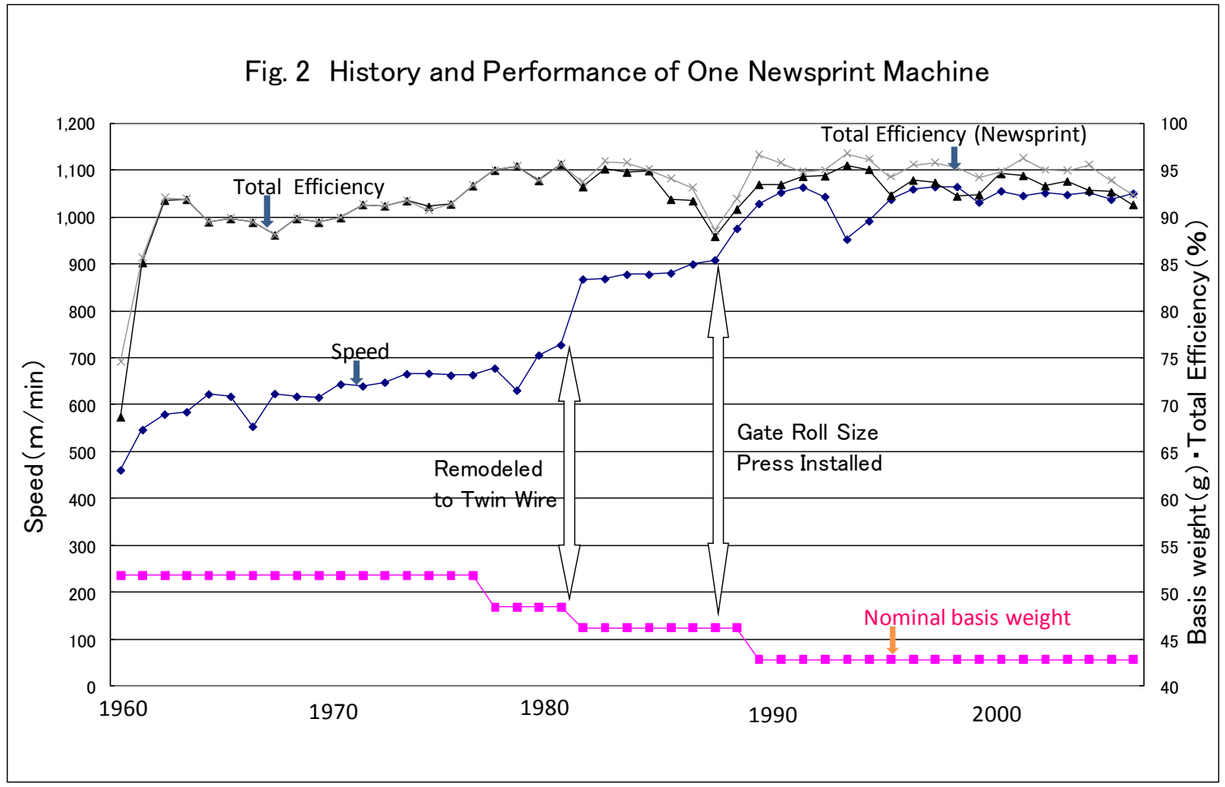


Table 1 History of newsprint quality

Table prepared on Jan. 7, 2007

	Nominal basis weight			H(51.8g/m²)						S(48.4g/m²)			L(46.2g/m²)					SL(42.8g/m²)					
	Machine #			4							4	6	6					8	8	6	6	6	6
	Sheet forming			Acid							Acid		Acid			Acid	Neutral	Acid	Acid	Acid	Acid	Neutral	Neutral
	Year				1978		1978		1978		1978	1989	1989	1989	1989	2001	2006	1989	1990	2001	2001	2006	2006
				Specification	Average	Specification	Average	Specification	Average	Specification	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
Sheet quality	Moisture	%		6～8	7.5	6～8	6.9	7.0	7.5		7.4	8.7	8.4	8.5	8.6	8.4	8.6	9.0	8.1	8.4	8.4	8.4	8.4
	Basis weight	g/m²		52～55	53.1	52～55	52.9	53±1	53.3	48.4	49.1	49.1	46.6	46.6	47.0	46.1	45.9	43.5	43.0	43.2	43.6	44.2	44.5
	Thickness	μ m		82～92	83.0	82～92	84.5		85.5		81.0	74.5	75.0	75.0	79.5	70.0	71.4	75.0	69.5	74.7	74.6	74.3	72.6
	Density	g/cm3			0.64		0.63	0.62 ↑	0.63		0.61	0.66	0.62	0.62	0.59	0.64	0.62	0.58	0.62	0.56	0.57	0.58	0.60
	Tear strength	gf	MD									28.6	24.0	24.4	25.0			25.0					
			CD	28 ↑	29.3	28 ↑	30.2	30 ↑	32.4	30 ↑	31.6	42.0	35.3	37.0	40.0	42.8	37.0	36.5	42.5	41.3	43.4	38.1	38.8
	Tensile strength	kgf	MD	2.7 ↑	2.85	2.7 ↑	2.82		2.37		2.12	3.22	3.63	3.62	3.75	3.53	3.81	3.40	3.27	3.74	3.79	4.04	4.06
			CD									1.12	1.24	1.24	1.33		0.73	1.16				0.73	0.74
	Elongation	%	MD		1.22		1.12		1.11		1.01	1.29	1.42	1.42	1.41	1.50	1.39	1.36	1.32	1.59	1.57	1.36	1.36
			CD										2.28	2.18	1.21		2.54					2.39	2.48
	Smoothness (F)*1	sec	Ave.									71	55	62	42	77	42	53	61	34	35	27	33
	Smoothness (W)	sec	Ave.	40 ↑	55	40 ↑	52	50 ↑	57		55	70	51	52	37	65	43	46	67	26	26	22	29
	Brightness	%	F	52 ↑	53.3	52 ↑	53.2	50 ↑	50.7	52 ↑	52.6	51.8	51.8	52.3	51.5	54.7	56.3	51.8	51.5	53.8	53.8	54.8	54.9
			W									51.8	52.0	52.2	51.5		56.1	51.9		55.4	55.4	55.2	55.2
	Opacity	%		89 ↑	91.4	89 ↑	91.9	93 ↑	94.4		91.8	91.6	89.4	88.9	89.3	94.4	95.5	88.6	86.2	93.3	92.6	95.2	95.5
	Friction coefficent											0.47	0.52	0.57	0.57	0.55	0.58	0.54	0.56	0.55	0.55	0.57	0.58
	吸油度	sec			57		47		47		39	71	65	65	68	88	63	76	59	70	80	58	60
	Ash content	%						3.0	3.5		3.1	3.2	2.3	3.3	2.9	6.2	11.5	2.7	1.8	5.6	5.1	11.9	12.0
	裏抜け値	%	F																84.6	87.5	85.3		91.2
			W																83.5	86.1	84.8		90.8
Finished stock	Mechanical pulp	%			85～100		85～100		83～84		82～84	46～51	38～42	33～47	24～25	70～80	70～80	48～60	48～60	22～34	20～32	15～25	15～25
	Deinked pulp	%			0		0		0			19～59	17～48	33～35	34～42	18～25	18～25	20～33	20～33	60～70	60～70	65～80	65～80
	Kraft pulp	%			0～15		15		16～17		16～18	16～19	27～28	23～29	25～40	2～4	2～4	20～22	25～27	6～8	8～12	6～10	4～10

*1: Measured by Bekk