welt, spiral and motif in 12" diameter, 14–32 gauge and 8 feeders.

As for the special type machines, Texima (East Germany) exhibited Maliwatt stitch bonding machine of Malimo types.

6. Conclusion

All textile consumption consists of 35% industrial, 33% clothing, 21% household goods and 11% housing interior decoration. Considering today's customers personality and feelings, more and more emphasis must be placed upon fashion. It seems like a system of small lot with variety in short term production must be taken as an important matter because of the novelty, scarcity and brief span of goods life. It is recognized that quite a lot of sample making machines and small lot productive machines were displayed in the 4th OTEMAS emphasizing a trend in the era.

Hereafter with regard to designing and manufacturing, it must be done rapidly, precisely and inexpensively by means of computer or other updated high technological devices. Thus, much more efforts in developing devices and systems in this field are highly expected.

Nonwovens Processing Machinery

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1. Introduction

In this 4th OTEMAS, actual nonwovens processing machines and its panels are exhibited at 52 booths. This number is just twice as much as previous OTEMAS. This fact shows undoubtedly that nonwovens are becoming the object of public interest. There are many new overseas exhibitors such as N. Schlumberger & Cie Group (France), Spinnbau Bremen GmbH (W. Germany), Hergeth Hollingsworth (W. Germany), Morrison Berkshire (U.S.A.), Foster Needle (U.S.A.), Machtex Holland B.V. (The Netherlands), Perfojet (France), Ommi (Italy) etc., in addition to domestic machine makers and trading companies.

In OTEMAS official guide book, nonwovens processing machines are classified into 7 groups, namely, lap forming machines, random webbers, needling machines, bonding machines, stitching machines, other nonwovens processing machines. It is doubtful whether this classification is good or not, because nonwovens processing machines make progress and involve many kinds of machines. In this paper, however, I would like to report nonwovens processing machines according to this classification.

2. Lap Forming Machines and Random Webbers

Iwamoto Seisakusho, N. Schlumberger & Cie Group, Nikki Machinery Co., Ltd. were registered in the section of lap forming machines, and N. Schlumberger & Cie Group, Nikko Trading Co., Inc., Hergeth Hollingsworth GmbH were registered to the section of random webbers also. Unfortunately, I could not see a random webber of N. Schlumberger & Cie Group.

In the lap forming machines, to unify the layered lap, to attain the wide range of weight per unit square and to control static electricity are aimed. Nikki Machinery Co., Ltd. exhibited horizontal crosslapper-NKL-33 (Fig. 1). The maximum width of card web is 3.3 m, the design and driving of traverse carriage is contrived to unify automatically the thickness at the ends of web in turn over, and to smooth the action at high speed range (80 m/min). This machine can produce the uniform web by using small adjustment function device. Crosslapper Model M-11M (Fig. 2) offered by

Iwamoto Seisakusho is 3.5 m width of card web, and adopts the carbon compound conveyer, and also solves the frictional loss and shock at the time of turn over by using the clutch brake and timing belt. And semi-random card Model HTC-9 built by Iwamoto Seisakusho has an combination roller doffing (C.R.D.) unit, can be used as draft action or condensing action by changing the ratio of circumference velocity between the stripping roller and redirecting roller. N. Schlumberger & Cie Group includes many companies such as A. Thibeau et Cie, Asselin, and Houget Duesberg Bosson, and Thinbeau nonwoven card CA6 Model B5 is the compact card having a main cylinder with 90 cm diameter and its
working width is 2.5 m and the production speed is 85 m/min. Asselin makes up the number of crosslappers having different card width (Model 140 – 475), these machines remove the bad effect of air flow according that two conveyer belts hold the card web, and prevent the collapse of the end of web by folding the web as compressing slightly between the bottom face of conveyer belt and upper face of floor apron, and also use the carbon coated PVC apron to electrostatic problem (Fig. 3). The crossliner CL 2000 built by Autefa Maschinenfabrik is the compact and high speed machine.

Hergeth Hollingsworth exhibits the nonwoven manufacturing lines (Fig. 4). The maximum production speed of this company’s card machine Akg-L-5-F1-d1-R2 is 180 m/min with maximum card width of 2.5 m. And there is also the compact design 850 card offered by Torigoe Spinning Machine Mfg. Co., Ltd. in cooperation with Hergeth Hollingsworth. New random card (exhibited with panel) built by Spinnbau Bremen is devised to close the MD:CD ratio (Strength ratio between the machine direction and width direction) to 1, utilizes the air flow generated between cylinder rotating in opposite.

Fig. 3 Crosslapper of Asselin

Maschinenfabrik is the compact and high speed machine.

Hergeth Hollingsworth exhibits the nonwoven manufacturing lines (Fig. 4). The maximum production speed

Fig. 5 Random Card type K21 of Textilmaschinenfabrik Dr. Ernst Fehrer

Fig. 4 Nonwoven manufacturing lines of Hergeth Hollingsworth
direction each other, and terminal MD:CD ratio of web becomes 1.3 - 2.0 : 1. The MD:CD ratio of random card type K21 built by Textilmaschinenfabrik Dr. Ernst Fehrer (Fig. 5) is 0.9 - 1.5 : 1 (according to a catalogue), and the working width is 1.0 - 2.6 m and production speed is 50 - 100 m/min.

3. Needling Machines

Ten companies were registered officially in this section (five domestic companies and five overseas companies). As the general trend, machines are considered to deal with easy and improved the maintenance ability, and can accept to the high-tech fibers. The high speed needle loom Model 350 built by Morrison Berkshire (Fig. 6) has four needle boards in both sides, produces for prepunchless web at the speed to maximum 2,000 strokes/min, and achieves the high maintenance ability by using the oilless beam guide system and needle plate covered with Teflon. Furthermore, it is said that the vibration and noise of this machine is very few. The speed of Asselin (member of Schlumberger group) needleloom (Fig. 7) is up to 2,500 strokes/min and has wide flexibility, and obtains the easy maintenance ability by taking high power module system. The maximum speed of the cylinder preneedler (cylinder tucker) Type 169DF (Fig. 8) is 500 strokes/min. This machine aims at the
uniformity of weight and at the prevention of web twist. This machine passes the layered web through the space between two perforated cylinders and needlings the web between cylinders with needle board in the cylinders at the same time. Dilo arranges wide range of needlelooms, Di-Loop DS-25 machine (Fig. 9) adopts the single driving system and has a patterning apparatus with high speed servo hydraulic system, and is suitable for making velours, rib and cord style. Di-Lour II is the high speed machine (1,700 strokes/min) for making velours, and can be used to produce a random pile velours having high pile density, and the number of needles per working width of 1 m is many. OD-IIS is also high speed machine with maximum 2,100 strokes/min, and suitable for low weight web and spunbonded nonwovens. NL-11/SE needleloom (Fig. 10) builted by Fehrer is equipped an electronic patterning apparatus, and its maximum speed is 1,000 strokes/min. The company's high speed random velour-punching machine Type NL-21/S-RV (Fig. 11) has the continuous automatic double cleaning apparatus, and can make velour constructions at up to 1,800 strokes/min with high efficiency.

4. Bonding Machines

There are many methods of bonding, and machine makers have developed the machines suitable for each method, and improved also. In this article, I will refer to bonding methods including to compound the materials. Eight companies were registered officially in this section. The dry bonding machine offered by Daitomi Co., Ltd. (exhibited with panel) is for the production of various kinds of products and the working width and production speed of this machine is 900 – 4,300 mm and 2 – 120 m/min. The Thermo-Hydrein Multi-roll Calender (Fig. 12) built by Rammishe Kleine-wefers GmbH equipped the system with nip pressure and temperature adjustable across the entire working width based on the conventional nipco system. The induction heated type thermobonding machine HCEM-IHP (Fig. 13) built by Uri Roll Co., Ltd. adopts the heat pipe type induction heating system,
the effective heating width of this machine is wider than
the conventional system and has a good heat conduc-
tivity and heat response. The ultrasonic is an attractive
new type for bonding. This is the method that thermo-
bonds the thermoplastic fibers by using vibration energy
caused by ultrasonics. Nikko Techno Co., Ltd. exhibits
Pinsonic (Fig. 14), and Div. of Emanson Japan, Ltd.

exhibits the ultrasonic bonding machine of this type.
The advantages of this method are high production
(maximum 100 m/min) and low energy consumption
(ten percent of calender method), and now can laminate
the different kind of 6 – 8 layered web.

The laminating machine (Fig. 15) built by Machtex
Holland B.V. adopts the binder spray method, and im-
proved the energy consumption, cost, operation ability
and texture. However, the spray head is exhibited only
at this time. In chemical bond method, foam bonding
system has been attracted the attention more than con-
ventional bonding system from the point of view of
reducing to half the quantity of pick-up. By using this
method, the texture of products becomes soft touch
because the content of binder is low, the production
speed is 100 m/min by combining Foam Impregnater
(Fig. 16) built by Fleissner GmbH & Co. and High
Performance Air Dryer.

5. Stitching Machine

Textima-Malimo and Yoshizumi Taketaro Ltd. were
registered in this section. Maliwatt N2400, Model 114010,
14 G (Fig. 17) built by Textima-Malimo has two way
of web delivery (continuous delivery method connecting
card machine and off-line batch method), and features
of this machine are low-space, operation ability and
high production speed.

6. Other Nonwovens Processing Machines and Acces-
sories for Nonwovens Processing Machines

Spunlace machine (Fig. 18) built by Perfojet uses
water-jet pressures up to 150 bars (200 psi) and four
stages water recycle system, can produce the products
with high absorbency and drapability. Temafa Textil-
maschinenfabrik exhibited the bale opener for non-
wovens, carding willow and fine opener FFO for pre-
opening of air-laid web (Fig. 19). Exactafeed FBK-
536 tuft feeder (Fig. 20) built by Trützschler GmbH
& Co. KG. achieves the stability of fleece feeding and
uniformity of weight across the width by using a multi-

(a) Bonding part
(b) Microphoto of melted spots

Fig. 14 Pinsonic of Nikko Techno Co., Ltd.

Fig. 15 Laminating machine of Machtex Holland B.V.
point regulation by microcomputer control. That is, the tuft web for feeding to the roller card is regulated along its length and across its width without interruption, and a tuft web of a specific profile across the width can also be delivered.

Induction heated jacket roller for high temperature built by Tokuden Co., Ltd. is proof against high temperature (300 – 420 °C), and achieves the low energy consumption and quick temperature response. Ashworth Bros. and Kanai Juyo Kogyo Co., Ltd. exhibited the card clothing for nonwovens. The foreign material detector FMD F-4 is used for distinguish and eliminate foreign materials in raw cotton after effect by bale opener. The accuracy of manufacturing of spinning plate (Fig. 21) for spunbonding built by Enka Technical GmbH is superior (The capillary has an accuracy ±10 micron in length and ±2 micron in diameter). In regard to felting needles, Foster Needle Co., Inc. and Singer Spezialnadel-fabrik GmbH exhibited. Foster’s Star Barb is designed to minimize the fiber damage by carrying fibers only with a needle having curved surface.

7. Conclusion

The Textile Machinery Society of Japan accepts the nonwovens first as an independent branch of reports of OTEMAS. This fact is a result of the development of
nonwovens industry and great interest to nonwovens in Japan. Though the classification of nonwovens processing machineries is described in sixth chapter of official guide book of OTEMAS, I think that it is not arranged in good order. It is necessary to classify into small group as nonwovens technology progress still more. If new original technologies for nonwovens processing machines suitable to current needs are not developed, the progress of nonwovens will not be expected.

I introduced main machines connected with nonwovens in this report. I regret to say that there were many panel exhibitions, because OTEMAS is a rare chance to see the actual nonwovens processing machines, in contrast with that nonwovens products are mainly introduced in other world scale exhibitions such as INDEX or IDEA.