UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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08895

DP/ID/SER.A/183
26 February 1979
English

DEVELOPMENT OF NONWOVEN TEXTILES*

SI/HUN/74/809

HUNGARY

Technical report: Selection of machinery for a new nonwoven line and work towards improving the product of the present line

Prepared for the Government of Hungary by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Philip A. Smith, expert in textile production

United Nations Industrial Development Organization
Vienna

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id.79-1240

Explanatory notes

The word "web" will be used to refer to card web only. The word "batt" refers to the fibre layer after the air-lay machine.

Reference to "tons" indicates metric tonnes.

The following abbreviations are used:

SD	Standard deviation
CV	Coefficient of variation
m/min.	metres/minute
g/m^2	grams/square metre
m^2/year	square metres/year
rev/min.	revolutions/minute
Fehrer	The K12 airlay machine made by Dr. E. Fehrer.

Abstract

In May 1975 the Hungarian Ministry of Light Industry requested the United Nations Industrial Development Organization (UNIOD) to assist it, through an enterprise and the Hungarian Textile Research Institute, in the development of nonwoven products and processes.

The project "Development of Nonwoven Textiles" (SI/HUN/74/809) was divided in two phases: the first phase concentrating on the introduction of chemically bonded nonwoven textiles was completed in October 1977 and the report was presented in November 1977 (DP/ID/SER.A/152).

The second phase has been split into two parts and this report covers only the first part of that phase.

A major part of the present work has been in making enquiries for a new nonwoven line to be installed in Lőrinci Textilipari Vallálat. At the time of writing only one answer has been received, but it is hoped that the work can continue during the coming year.

A number of investigations have been made concerning the unevenness of the fabric and recommendations are made. The existing quality control methods have been investigated and discussed. Again recommendations for the future are made.

A trial has been run to produce 100% viscose rayon fabric of 30 g/m2 and 60 g/m2.

Suggestions have been made to explain the variation in weight per unit area of the fabric.

A trial has been run to select a new type of polyester fibre to replace the one currently being used.

A number of modern surgical dressings have been discussed with Rico Vallálat.

A number of modern nonwoven products have been discussed with Lőrinci Textilipari Vallálat, with a view to suggesting new products for them.

Contents

Introduction

Project background

In 1974 the annual production of nonwovens in Hungary was 2.5 million m2. During 1977 a new nonwoven line was commissioned which increased the production by a planned 7 million m2/year.

It is planned in the near future to establish another nonwoven line at Lőrinci Textilipari Vallálat to produce 30 million m2/year mainly of light weight nonwovens for sanitary purposes (15 g/m2), but also other fabrics up to 60 g/m2. It is felt that the plant must be made very versatile, due to the limited size of the home market in Hungary.

Objectives of the mission

The major objective of the mission was to design the newest nonwoven line and to select the machinery with which to build it up.

A secondary objective was to identify the causes and to rectify the faults being produced on the existing plant. Also to give some help in establishing quality control procedures and in the establishment of new products.

I. FINDINGS

1) The new plant

By discussions with the plant management the basic outline of the newplant has been decided. It was found that it would be both cheaper and more convenient to use a new blending system, rather than to share the existing blending system between the existing and the new plant. It is cheaper because the cost of storage bins to hold the fibre between the blending system and the cards would be considerably greater than the cost of a simple blending plant. It is also more convenient because it cuts down the possibility of getting fibres from one plant mixed in with fibres from the other.

Further decisions were to use either two cards working in parallel-lay or a specialized random card, to equip the line with both a heated calender for thermal bonding and also with a print bonding unit. A cylinder dryer would be used to give greater thermal efficiency and to take less space. Since the plant would run at high speed it was decided to use a wind-up with automatic change and to edge trim the fabric and slit to the width required by the customer at a station off the line.

It was also decided if possible to buy all machinery from one manufacturer or consortium. At the time of writing only two offers have been received, though about twenty five requests have been sent out. It is therefore too early to make any comparisons or recommendations.

2. Surface appearance of the fabric

The appearance of the fabric is at present spoilt by four types of faults.
a) neps
b) cloudiness
c) periodic faults in the centre of the fabric
d) waste carried up by the conveyor from under the Fehrer.

All these faults are created by the Fehrer machine. The polyester fibre being processed at the time was particularly difficult, probably due to insufficient application of anti-static by the fibre manufacturer. Representative samples of fibres were tested by the Hungarian Textile Research Institute (see Appendix 3), but in the first test one sample was tested in a different way, so the test was repeated. The poor corelation between the sets of results does not give much confidence in them. It is intended to repeat the test in Leeds using a different instrument.

It has been found that fibre treated with an additional 0.1% of anti-static finish and processed damp gave less static problems, particularly less waste under the Fehrer and less neps.

The relative humidity has an important bearing on static formation, but this was observed by the meter to be as low as 50% on some days, compared with a recommended value of 60 - 70%.

The formation of neps is largely caused by the failure of fibres to leave the main cylinder of the Fehrer. If carried round a second time they are likely to become tangled with the fibres being fed in. It has been observed that there are small grooves which have been worn by the fibres into the leading edges of the metallic teeth. It is thought that the fibres become caught in these grooves and fail to release in the normal way. There is no way of removing these grooves, so the metallic clothing on the roller will have to be replaced.

The regular fault was observed to repeat at intervals of 8 seconds, so is probably caused by a roller rotating at 7½ rev/min.

The most probable roller is the worker, which may have a slight eccentricity in the centre, causing it to pick up more and less fibre as it rotates.

3. Quality control methods

a) Control of incoming raw material

Since the fibre, binder etc. is all bought from reliable suppliers with their own quality control systems, it seems pointless to have a regular testing system for incoming raw materials. If something goes wrong, the raw materials should be checked, but since this should be a rare event the testing could be more cheaply done by the Textile Research Institute.

b) Control of weight per unit area

i) It was noted that the scale used for checking fabric weight had too much friction in it and could be made to read ± 0.5 g. This is equivalent to ± 2g/m2, which is quite large.

ii) A 24 hour test was run on fabric V2 in which 4 samples of 50 cm x 50 cm were taken every two hours. Analysis of the results (Appendix 4) shows that there is a close association between the four samples, so that it is possible to control using only two samples as before.

It will be seen from Appendix 4 that the fabric is always light on the left hand side and heavy on the right. This is caused by the cross lapper stretching the card web slightly on one side of the fabric. It occurs very commonly and is very difficult to correct. However this causes the mean of the A + B samples, which are normally taken, to be 2% heavier than the overall mean. Hence the desired mean of the A + B samples should be (fabric weight +2%). From the variation between samples it has been calculated that warning limits should be set at ± 6% from the desired mean and action limits at ± 9%. Taking all these figures together the warning and action limits are as shown in the table below.

Warning and Action Limits for Mean of two samples

Desired fabric weight	Lower action limit	Lower warning limit	Upper warning limit	Upper action limit
30 g/m2	7.0 g	7.2 g	8.1 g	8.3 g
40 g/m2	9.3 g	9.6 g	10.8 g	11.1 g
50 g/m2	11.6 g	12 g	13.5 g	13.9 g
60 g/m2	13.9 g	14.4 g	16.2 g	16.7 g
70 g/m2	16.3 g	16.8 g	18.9 g	19.4 g

It is recommended that these limits should be used in normal quality control chart form. Alternatively the results can be recorded as at present in a book, but this does not reveal trends in the same way. The mean of the A + B results are shown plotted in Appendix 5. 4 results lie below the action limit, which is mainly because the fabric was approximately 5% light on average all the day. It will be noticed that the action limits approximately correspond to the tolerance of ± 10%.

The practice of weighing 300 m lengths is a useful indication of the mean weight/unit area, but it cannot be regarded as a quality control technique because the fabric is often not weighed until one or two days after it was made. It is obviously then too late to take any remedial action.

c) Short-term irregularity or cloudiness

The present test of weigh 12 10x10 cm samples is based on a Hungarian standard for woven fabrics. It is quite unsuitable for non-woven fabrics, which are more variable and will give very variable results. It is therefore recommended that this test be discontinued as a regular test procedure.

However it is desirable to measure short-term irregularity from time to time, especially as an aid to obtain the best settings on the Fehrer. In this case the test should be made by weighing about 200 10 x 10 cm samples to obtain reasonable accuracy or it can be done more rapidly by visual assessment.

Such a test has been done to compare a commercial English interlining with V 2. The results are shown below.

	Vilene	V2
Weight/sq.m.	36.6 g/m2	39.7 g/m2
Total variation CV	[illegible].97%	[illegible].57%
Variation along fabric CV	6.47%	3.34%
Variation across fabric CV	2.51%	5.70%

These results show that the V2 being made at present is as good as a commercial English product of similar weight. However it can be seen that the variation along the fabric is better than the English one but the variation across is worse. To obtain an improvement the cross lapper would have to be improved, which is difficult, but an easier improvement could be achieved by preventing the thick edges, caused by the side plates on the Fehrer.

d) Other properties

The recovery from creasing is already being measured at the factory. Other important properties are:

i) resistance to solvents;

ii) resistance to delamination;

iii) resistance to abrasion and pilling;
iv) tensile strength in two directions.

Methods of tests for these properties will be found in DIN standards, EDANA standards, etc., but new Hungarian standards are also to be published soon.

4. <u>Production of 100% rayon fabric</u>

The production started with a fabric of 30 g/m2. It was found that using the normal impregnating technique, the foam would not penetrate through the fabric. In order to get sufficient penetration the percentage of binder was increased until finally there was so much binder penetration that the fabric stuck to the hot dryer lattice. The fabric was too weak to pull off the lattice and the small samples produced were found to be very stiff and paperlike.

In view of the poor binder penetration the 60 g/m2 fabric was impregnated from both sides. This gave good binder penetration but the percentage binder in the final fabric was too high, resulting in a stiff, paperlike product. The fabric also showed the usual "bubbly fault". The trial was not a success and no usable fabric was made.

5. <u>Reasons for long-term variation of weight/unit area</u>

First it should be pointed out that in the 24 hour period referred to in Section 3 it was found that the fabric always lay within the tolerance limits of $\pm$ 10%. The situation is therefore not so bad.

It is thought that there are three main reasons for long-term variation.

a) The chute feed. It was shown that the chute feed gave a maximum variation of $\pm$ 7%. Allowing for the doubling at the cross lapper this may cause a long-term variation of $\pm$ 3-4%. It is doubtful if this can be improved upon, except using an automatic control system, which would be expensive and probably complicated to fit.

b) The foam unit. It has been observed that manual changes are continually made to the foam unit, to correct slight faults in the impregnation. It cannot be argued that these changes are unnecessary, but equally they must lead to changes in the amount of bonding agent applied. It is estimated that this may cause a further 2-3% variation.

c) It is also noted that all operatives alter speed controls which change the tension in the fabric. Again they probably make the alteration to improve some aspect of the performance, but it may cause a further variation of 1-2%.

6. The cause of "bubbles" in the fabric

Two or three observations have been made which help to isolate the cause of the bubbles.

a) "Bubbles" were still a bad problem with 100% viscose, so the bubbles cannot be caused by bad blending of the viscose and polyester fibres, which was one previous theory.

b) When the machine was slowed down from 9 m/min. to 5.5 m/min. the bubbles reduced considerably. This could be due either to changes in the regularity of the Fehrer batt or to changes in drying conditions. Since no change could be observed in the Fehrer batt it is concluded that the bubbles are created in the dryer.

c) Normally when the machine is slowed down as in b) the bubbles disappear completely. On this occasion they did not, but it was found that the first fan in the dryer was not operating. This is a further point indicating that the dryer conditions are critical.

All these points tend to confirm the theory put forward previously, that the bubbles are caused by differential drying rates in the thick and thin places, together with shrinkage of the rayon.

Since the first fan was not repaired, it was decided that there was no point in "tuning" the dryer without it in operation.

7. Selection of a new type of polyester fibre

A test was run using the normal machine settings to compare three types of polyester fibre with the existing Vestán fibre that was being used. The opportunity was also taken to compare Vestán used straight from the bale with Vestán to which an additional quantity of anti-statio agent had been added. The results were

a) Vestán from the bale. This fibre showed signs of severe static at the Fehrer. There was also a serious production of neps.

b) Vestán with additional anti-statio. The problems of static electricity were cured, but the fabric still showed a lot of neps.

c) Trevira 1.7 dtex. There were no static problems with this fibre, but the nep problem was very severe.

d) Trevira 1.3 dtex. Again there were no static problems, but the production of nep was extremely severe.

e) Trevira 2.4 dtex. This fibre processed without any difficulty on the Fehrer, but due to the greater coarseness of the fibres the batt was thicker and more difficult to impregnate.

In view of the observation in Section 2 that the clothing on the Fehrer was worn, it is recommended that further tests be postponed until this defect is rectified. Otherwise a perfectly satisfactory fibre could be rejected.

8. <u>Samples of medical and surgical dressings</u>

A series of medical and surgioal dressings, including the most modern available, were discussed with the staff of Rico Vallalat. The chief points in the discussion were

a) the price paid by the National Health Service for some of the common items: this information will be forwarded, if it is possible to obtain it.

b) Why the British authorities had permitted the use of viscose rayon in surgical dressings, but the Hungarian authorities still refused to do so. An attempt will be made to find copies of official documents on this subject, though again this may prove impossible.

c) The relative cost of gamma ray and steam sterilisation. In this case an article showing the cost of sterilisation by radiation and the extent of its use was already available.

9. Production of non-wovens from 100% polypropylene fibre

This part of the work programme had to be abandoned because it proved to be impossible to obtain a supply of the correct type of polyester in time.

10. Discussion of current non-woven samples from Britain

A series of non-woven samples comprising practically every item available in retail shops was brought to Lőrinci Textilipari, together in some cases with the woven or knitted competitive fabrics. The discussion centred particularly on methods of production, prices and the differences between the British and Hungarian markets. In designing and selling new products on the market in Hungary, the experience in Britain should prove to be a guide, but there are important differences which should not be overlooked.

A sample of non-woven felt used for the automatic watering of greenhouses in Britain was left with the Textile Research Institute, who were interested in developing this product.

II. RECOMMENDATIONS

1. New Plant

It is too early to make any firm recommendations about the new plant. It is intended to continue to work by correspondence with Rővidáriuipari Egyesülés during the ten months before the final part of this project.

2. Pilot-scale plant for development and research work

It is becoming essential that Lőrinci Textilipari Vallalat should have a small-scale plant on which development work and experimental work can be carried out. This is because there is a need to develop new products, but the large plant cannot be spared for this development work. Equally, there is a need to solve production problems and again the large plant cannot be spared for this work.

I have heard arguments that the small-scale plant should be controlled by the Textile Research Institute and used by Lőrinci T.V. Speaking entirely independently I do not think this would be a good idea, for two reasons. Firstly, because Lőrinci T.V. would be in a position to use the small plant for small orders when it was not required for research work. Secondly Lőrinci T.V. are in a better position to run the plant and to decide on the type of development required. Consequently, I believe the pilot plant should be controlled by Lőrinci T.V. and used for research work by the Textile Research Institute.

The pilot plant could be made of three different complexities and could perhaps be built up in these three stages.

Stage 1

Use waste lap from the Fehrer, foam made while the plant is standing and the main dryer during a break in normal production. The only cost would be an impregnation unit consisting of two metal rollers 1 - 1.1 m wide capable of being set to each other with great accuracy.

Stage 2

A discontinuous plant consisting of a single cylinder card producing a short parallel-laid batt by wrapping onto a drum of 1 - 2 m diameter, i.e. 3 - 6 m of batt. Alternatively or as well an old Blamine lap-former could be used to give about 6 - 8 m of cross-laid batt. Hand blending could be used and material requiring 2 carding cylinders can be passed through the system twice. The impregnation system described in stage 1 could be used and drying could be done by a laboratory scale oven with a circulating fan.

Stage 3

Neither of the above stages are continuous. The simplest plant to give continuous production, and the one which should be aimed at eventually, would consist of the following:

a) blending and opening on one of the existing plants during a break between lots;

b) a hopper-fed two cylinder card 1 - 1.5 m wide. Preferably a second-hand one, but in good condition or it will not card 1.7 dtex fibres well;

c) a simple cross-lapper, preferably of the "camel-back" type;

d) there should be the possibility of wrapping a discontinuous parallel-laid batt onto a drum as before, but this would be discontinuous;

e) the impregnation system as in stage 1, but now requiring its own foam production unit;

f) a one-layer dryer with continuous lattice, possibly converted from an old stenter, but with care taken about temperature control and the control of air currents;

g) a simple wind-up system.

3. The improvement of the surface appearance

a) Occurrence of neps

It has been found that the teeth of the main cylinder are worn, with grooves which will tend to hold fibres. It is thought that this is a major cause of neps.

The cylinder should be reclothed in metallic wire, if possible without removing it.

It seems likely that the cylinder will required reclothing regularly about once per year. If this is considered to be too frequent it is possible that another manufacturer of metallic clothing could give better quality teeth. Another possibility which is worth discussing is the use of steel pins instead of metallic wire. These are made by W^{m} Stewart, Marine Parade, Dundee and have been found to give a much longer life in open-end spinning, which is a similar situation. It is quite likely that Stewarts have never made anything so big as a Fehrer main drum, and it may be very expensive, but it seems to be worth asking both Fehrer and Stewarts for their opinion.

If the present supply of Vestán continues to run badly even with the new clothing, further trials should be made with different levels of anti-static addition and with different levels of moisture in the polyester as it is fed to the hoppers.

Attention should also be paid to the humidification system, which often gave a relative humidity of only 50%, though the machine manufacturers ask for a humidity of between 60 - 70%.

b) Cloudiness

It should first be noted that a standard sample of V2 was just as good as a standard sample of Vilene, so the cloudiness problem is not too great.

It was thought that settings of the Fehrer to improve nep made cloudiness worse and vice versa. If this is so, and the nep problem is removed by the new clothing, the setting of the Fehrer can be done concentrating on cloudiness. It is felt that it will be best to judge cloudiness visually, e.g. against an illuminated screen, rather than try to cut and weigh 200 samples each time.

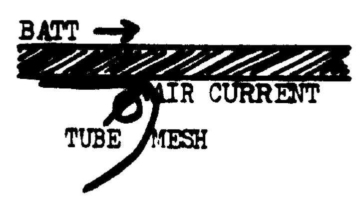
It is also thought that some cloudiness may be caused by tufts of fibre pulled away from the feed roller by the main drum of the Fehrer and not broken up by the two workers. The closest possible settings should be used to prevent this. It is also suggested to try feeding the Fehrer at a higher speed with a lighter cross-lapped material. It is realized that this will reduce the number of doublings before the Fehrer, but it will also increase the amount of doubling after it. It is also in line with the thinking of Dr. O. Angleitner, who feeds his airlay machine with 10 g/m2 card web at 90 m/min. The higher speed will also tend to reduce the work done by the teeth of the main drum and may therefore reduce the wear on the teeth.

c) Regular fault in the centre of the fabric.

The regular fault repeats at intervals of 8 seconds, so is almost certainly caused by a roler rotating at 7½ rev/min. e.g. a worker.

d) Faults caused by waste under the Fehrer.

Waste under the Fehrer is basically caused by the strong suction from the three fans, plus the effects of static electricity. If this waste continues to be a problem it is recommended that a tube with a narrow slot should be placed across the machine at the point where the Fehrer batt leaves the mesh conveyor. A gentle air stream through the slot should cause all the fibres to leave the mesh and so prevent any waste.



SKETCH

4. Quality control

a) It is recommended not to test incoming raw materials regularly but only as a means of proving that either fibre or binder is faulty.

b) It is recommended to purchase a better balance to use inside the factory.

c) It is recommended that 2 samples of fabric be weighed every two hours; action limits should be Desired mean -7%, and +11%
warning limits should be Desired mean -4%, and + 8%.

The limits are not symmetrical because the samples are taken from the heavy side of the fabric.

d) It is recommended to stop weighing 12 10 x 10 cm squares from each fabric because this does not give a reliable indication of irregularity. Instead it is recommended to buy or make a lighted screen to view the fabric against and to judge cloudiness visually.

e) It is recommended that the fabric be tested for delamination and solvent resistance by placing samples in a closed vessel with small weights and a solvent i.e.(perclorethylene). The vessel should be rotated at about 10 rev/min. for two hours and the samples can then be assessed. Standards must be built up from experience.

5. 100% rayon fabric

It is recommended to use a more dilute binder and one of a softer type in the next trial.

6. Long-term variation

a) An enquiry has been made into the possibility and cost of fitting an autoleveller to the chute feed.

b) An attempt should be made to find stable impregnating conditions and to discourage any changes in these conditions.

7. Bubbly fabric

a) It is recommended that dryer temperatures and dryer air controls should be adjusted to improve the bubbly appearance.

b) It is thought that the present impregnating conditions make the fabric far too wet, making drying more difficult and also encouraging binder migration and delamination. It is recommended that experiments be made using two solid rolls for impregnating, preferably two metal ones and on a pilot-scale to save expense.

8. Choice of polyester fibre

It is recommended that the choice of polyester fibre be left until the Fehrer has been reclothed.

APPENDIX I

Work Programme

1. To make suggestions for developing a non-woven line for producing fabrics in the range 15 g/m^2 to 60 g/m^2 suitable for hygienic, medical and other purposes. The line should be designed to fit into an existing room.
2. To find the solution for the unevenness in the nonwoven fabrics being made at present, including neps and the uneven surface appearance.
3. To investigate and revise the existing quality control methods and the testing of raw materials and finished fabric. (Also to make suggestions on the purchase of testing equipment).
4. To assist in the trial production of 100% rayon fabric weighing 30 g/m^2 on the existing line.
5. To find out why the product varies in weight/square metre when the machine settings are left unaltered.
6. To find out the reason and suggest a cure for the "bubbles" which still exist in the 80% rayon fabric.
7. To assist in problems associated with changing the type of polyester fibre from Bayer to another supplier.
8. To discuss with Rico Vallalat the samples of surgical dressings brought from Britain.
9. To assist in producing a non-woven from 100% polypropylene for use in medical dressings on an experimental basis.
10. To discuss with Lőrinci Textilipari and the Textile Research Institute current samples of nonwovens made in England.
11. To write a report for UNIDO and for the Ministry of Light Industry.

APPENDIX II

A lecture was given to the

Textilipari Müszaki és Tudományos Egyesület in Budapest on 7th September 1978 on the subject

"Kutatási eredmények a tűnemezelésben"
(Recent research in needle punching)

The lecture was interpreted into Hungarian and there were about 25 people present.

APPENDIX III

Values of Resistance of Various Fibres

All in Ω kg/m^2

	First test	Second test
Vestán 1.7 dtex/40 mm from bale	2.11×10^{10}	1.25×10^{11}
Vestán 1.7 dtex/40 mm stacked	3.06×10^{12}*)	3.94×10^{10}
Trevira 120 1.7/38 mm	1.98×10^{9}	1.30×10^{10}
Trevira 120 1.3/38 mm	2.99×10^{10}	1.30×10^{9}
Trevira 220 2.4/38 mm	2.26×10^{9}	2.5×10^{9}
Grilene F 1.7/51 mm	5.60×10^{10}	
Grilene B 1.7/38 mm	2.56×10^{9}	
Elena 1.7/38 mm	2.91×10^{9}	

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*) this partioular test was done in a different way

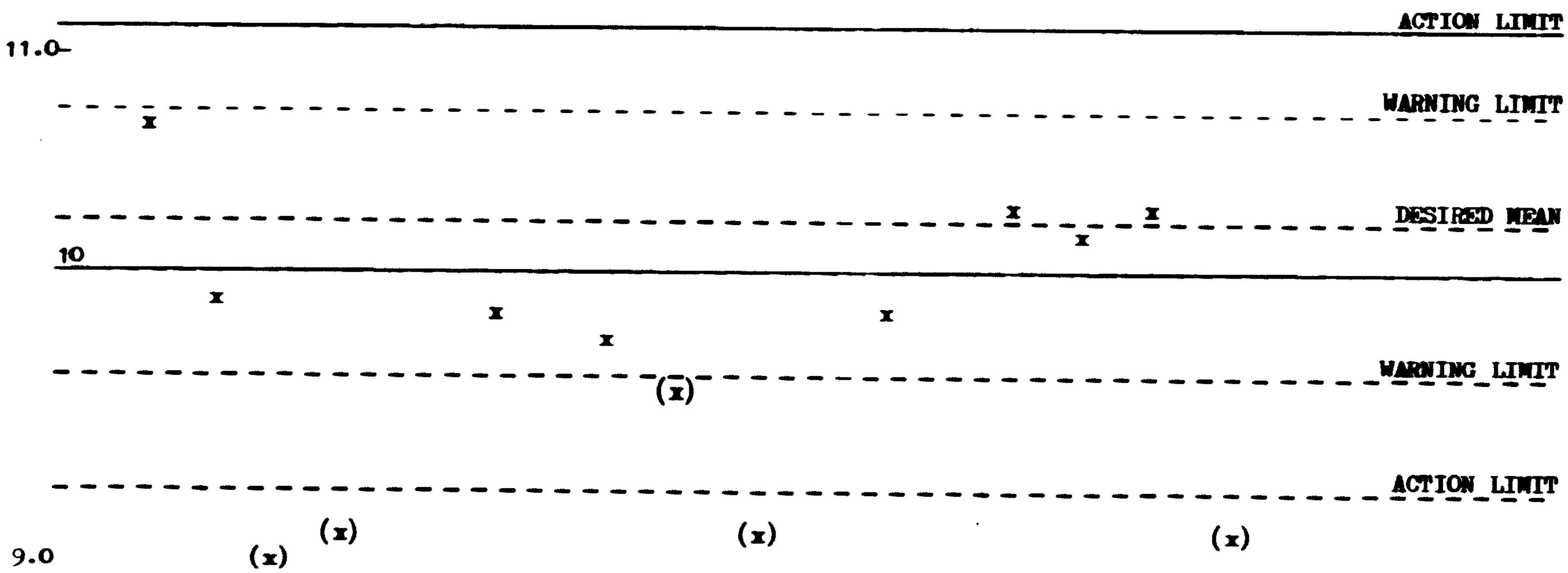
APPENDIX IV

Sample Weight in Grams

Time	Left C	A	D	B Right	Mean	AB Mean
14	11.8	10.2	10.1	11.2	10.8	10.7
16	9.1	9.7	10.0	10.1	9.7	9.9
14th 18	8.6	8.3	8.7	9.6	8.8	8.9
20	7.7	8.9	8.7	9.1	8.6	9.0
22	9.4	9.8	9.5	9.9	9.65	9.85
24	8.7	9.5	9.5	10.0	9.4	9.75
02	8.5	9.4	9.1	9.5	9.1	9.45
04	8.5	8.9	9.1	9.1	8.9	9.0
06	8.6	9.6	9.3	10.1	9.4	9.85
15th 08	10.8	10.6	10.5	10.0	10.5	10.3
10	9.8	10.0	9.1	10.2	9.8	10.1
12	10.0	9.8	9.8	10.7	10.1	10.25
14	8.6	9.3	9.3	8.8	9.0	9.05
Mean	9.24	9.46	9.44	9.87	AB Mean	9.70
		Grand Mean	9.52			

APPENDIX V

QUALITY CONTROL CHART USING THE MEAN FROM THE A AND B SAMPLES



Appendix VI

RECORD OF DISCUSSIONS HELD AT
LOIMCI TEXTILIPARI VALLALAT

DISCUSSION ON 20TH JULY 1978

The draft work programme was discussed and a number of additional items were suggested. At the end of the meeting a final version of the work programme was agreed by everyone.

DISCUSSION ON 27TH JULY 1978

This discussion concerned only suggestions and ideas for the new plant. The following points were generally agreed.

1) It would be desirable to buy the whole line from one supplier.

2) To investigate three possible methods of feeding raw material.

3) To investigate the possibility of including an automatic control to the chute feed.

4) To investigate random cards, compact cards and the Isomiser as methods of batt production.

5) To investigate print-bonding methods followed by a cylinder dryer.

6) To include a heated calender for thermal bonding, but not to include foam impregnation.

7) To suggest methods of batching and cutting on or off the line.

DISCUSSION ON 17TH AUGUST 1978

The Hergeth Quotation

The quotation received from Hergeth was discussed in detail. It was generally agreed that although it gave adequate descriptions of the machines, the quotation was lacking in details of performance, production, fabric quality, etc.

It was decided to write a long series of questions designed to fill in the required information, in particular

1) could a batt weight of 10 g/m^2 be made?
2) what levels of atmospheric control were required?
3) was it possible to build in automatic control of batt weight?
4) what were the steam demands?
5) what was the total demand for electric power?

DISCUSSION ON 30TH AUGUST 1978

1) **Production of 100% viscose fabric**

a) 30 g/m^2. The fibre batt could be made without difficulty, but it was found that the bonding agent would not penetrate through the dry batt, so that a one-sided product was made. When more bonding agent was applied to obtain better penetration the wet fabric stuck to the dryer lattice. Only a small piece of fabric was made, and this was very papery in handle, due to the high percentage of binder.

b) 60 g/m^2. Again there was difficulty in getting binder penetration and binder had to be applied from both sides. The quantity of binder applied was high and all the fabrics were papery in handle. One or two different binders were use but there was no great improvement. The fabrics all showed the usual "bubbly fault".

2) <u>Experiments to prevent the "bubbly fault"</u>

a) Previous experiments had shown that the fault was caused during the drying process. Since the first fan in the dryer was out of operation it was decided that it was futile to make any experiments until the fan was repaired.

The question of impregnation was also raised at this stage and it was pointed out that the liquid pick-up using the present system was too high. It was thought that a system using plain rollers, either both metal or one metal and one rubber-covered would give a lower binder pick-up and would help to remove the "bubbly fault". It would also reduce the amount of binder migration and delamination.

3) <u>Trial of different polyester fibres</u>

It was decided to compare all the types of polyester fibre available in the factory, using the same standard setting, with the intention of selecting a fibre to replace the Vestán currently being used.

4) <u>Experiments with the Fehrer</u>

It was decided that experiments with settings on the Fehrer would be made using the stacked Vestán used for normal production.

DISCUSSION ON 8TH SEPTEMBER '78

1. Comparison of irregularity between Vilene and V2

a) Both materials were of almost exactly the same weight/unit area, so that the comparison was not biassed.

b) By cutting and weighing 10 x 10 cm squares the short-term irregularity was compared. It was found that the general irregularity was the same in both fabrics.

c) The irregularity along the fabric (machine direction) was greater in the case of the Vilene. This is probably caused by the drafting after the cross-lapper.

d) The irregularity across the fabric (cross direction) was greater in the case of V2. This indicates that the cross-lapper is not quite as good as that used by Bondina. The irregularity was also increased by the heavy edges caused by the side plates on the Fehrer. If these two points could be improved, V2 could be better than Vilene.

2. Comparison of different polyester fibres

Five lots of polyester fibre were processed at the same settings for comparison.

a) Vestán x 210 1.7 dtex 38 mm from the bale.
57% R.H. Measured resistance $1.25 \times 10^{11}\,\Omega\ \mathrm{kg}\ \mathrm{m}^{-2}$

This fibre was difficult to process due to excessive static electricity generated at the Fehrer. Clumps of fibres clung together to form balls; other fibres recirculated to form neps. The web was patchy and a lot of fibre stuck to the Fehrer conveyor belt, leading to waste under the machine. Some waste was carried up to form serious faults in the fabric. 102 neps/g were found in the fabric.

b) Vestán x 210. 1.7 dtex 38 mm after stacking

57% RH. Measured resistance $3.94 \times 10^{10}\ \Omega\ kg\ m^{-2}$

This fibre showed no particular static problems, but some neps were still formed by fibres recirculating the main cylinder. There was some fibre sticking to the Fehrer conveyor belt, but much less than before. The improvement caused by stacking was very great, but could be due either to the anti-static; to the remaining water or a combination of both. About 30 neps/g of fibre were found in the fabric.

c) Trevira 120 1.7 dtex 38 mm from bale.

58% RH. Measured resistance $1.30 \times 10^{10}\ \Omega\ kg\ m^{-2}$

This fibre seemed to process without any noticeable static problems, which is in agreement with the low measured resistance. However the fibre formed a lot of neps, and from this point of view was even worse than Vestán from the bale. No reason for this could be seen. About 250 neps/g of fibre.

d) Trevira 120 1.3 dtex 38 mm

54% RH. Measured resistance $1.3 \times 10^{9}\ \Omega\ kg\ m^{-2}$

Although this fibre has a low measured resistance, there was some evidence of static problems, leading to large lumps in the web. However by far the most serious problem was nep formation. It is thought that this is caused by the light weight fibres not being thrown clear of the main cylinder, and so being recirculated. There was no waste under the machine. About 600 neps/g.

e) Trevira 220 2.4 dtex 38 mm. Bright fibre

54% RH. Measured resistance $2.5 \times 10^{9}\ \Omega\ kg\ m^{-2}$

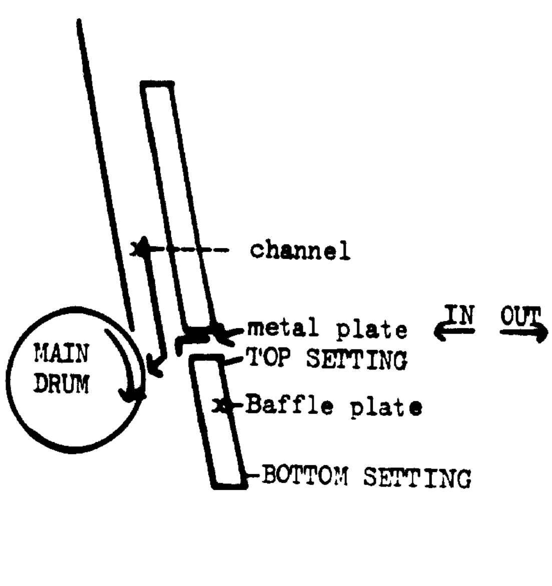
This fibre showed no static problems, no waste problems and made virtually no neps. However due to the coarse fibre the web was

thicker and more difficult to impregnate. New impregnating conditions will have to be found.
The ccarser denier will be expected to give a weaker fabric and a slightly harsher handle, but if these are acceptable a fibre decitex of 2.0 to 2.5 will be easier to process on the Fehrer.

3. Fehrer experiments

The first general observation was that when the plant was processing continuously and normally, the nep production was quite reasonable. As soon as the plant was stopped, conditions became much worse. It was thought that this was due to the stacked Vestán fibre drying out. However it was pointed out that the Fehrer could take two or three days sometimes to "recover" after an alteration. No logical explanation for this could be found, other thanpossible changes changes in the relative humidity or the stacking conditions.

Measurements of speed on the Fehrer showed that the surface speed of the main cylinder was about twice the speed of the centrifuge fan. It therefore seems that fibres must be thrown off the main drum by centrifugal force and then be removed by the air stream. The control of the air stream must aim to carry the fibres away and must avoid any tendency to hold the fibres against the teeth. For this reason slow air speeds and air currents directed towards the main cylin'er should be avoided. The main purpose of the experiment described below was to find if a small metal plate at the bottom of the main channel, which appeared likely to cause an air current towards the main cylinder, had any significant effect. The layout is shown below in a sketch for clarity.



Experiment 1 Normal

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
50%	IN	20	4	3.2	3.2

The impression of the fabric was that it was quite uniform and had relatively few neps.

Actual number counted 52 neps/g.

Experiment 2 As exp. 1 but with metal plate moved out

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
51%	OUT	20	4	3.2	3.2

General impression. Fabric more patchy, rather more neps and static problems worse.

Number of neps counted 79 neps/g.

Experiment 3 As exp. 2 but with the top of the baffle plate moved inwards, to close the gap between it and the channel.

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
50%	OUT	20	4	2.3	3.2

General impression. Batt patchy and more neppy. Waste causedby static worse.

Actual nep count 109 neps/g.

Experiment 4 As experiment 3, but with bottom part of baffle plate moved outwards.

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
50%	OUT	20	4	2.8	-1.5

General impression The open setting of the bottom part of the baffle plate allowed fibres to blow all over. The nep problem was still as bad and waste still stuck to the conveyor belt.

Actual nep count 215 neps/g.

Experiment 5

In this experiment the channel setting was reduced to 10, the baffle plate was moved in at the bottom and the relative humidity was raised by soaking the floor with water.

Experiment 5

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
54%	OUT	10	4	2.8	2.5

General impression. The nep problem did not seem to be significantly improved.

Actual nep count 107 neps/g.

Experiment 6

As experiment 5 but increased fan speed to 5.

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
54%	OUT	10	5	2.8	2.5

General impression. The high fan speed caused even more waste on the conveyor belt and also made "strings" or "pseudo yarns" in the fabric.

Actual nep count 110 neps/g

Experiment 7

Similar to experiment 3 but with higher humidity

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
54%	OUT	20	4	2.8	2.5

General impression. Still a lot of nep and a lot of waste on the conveyor belt.

Actual nep count 143 neps/g

Experiment 8

As experiment 7 but with higher fan speed

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate Top	Baffle plate Bottom
54%	OUT	20	4½	2.8	2.5

General impression. A lot of nep and also waste on the conveyor. Some formation of "pseudo yarns" caused by the high fan speed.

Actual nep count. 96 neps/g

Experiment 9

As experiment 7 but channel opened to 30

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate	
				Top	Bottom
54%	OUT	30	4	2.8	2.5

This condition reduced the waste on the conveyor and the amount of nep seemed to be reduced too.

Actual nep count 63 neps/g

Experiment 10

As experiment 9 but with high fan speed

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate	
				Top	Bottom
54%	OUT	30	4.5	2.8	2.5

Again the higher fan speed made "pseudo yarns". No samples taken.

Experiment 11

As experiment 1 i.e. normal condition

Relative humidity	Metal plate	Channel	Fan speed	Baffle plate	
				Top	Bottom
54%	IN	20	4	3.2	3.2

As sample was taken after about 30 minutes running. In spite of the higher humidity the nep count was much worse than the original, obtained with continuous running. The fabric was also more patchy.

Actual nep count 140 neps/g.

General conclusions

1. A fan speed above 4 caused "pseudo yarns" to be formed.
2. If the plant is stopped it takes some time for good quality material to be produced. This could be due to the fibre drying out.
3. Since several of the experiments were better than experiment 11 for nep count, it is worth trying the best ones for a longer period of time.

DISCUSSION ON 15TH SEPTEMBER 1978

A final discussion was held with a member of the Ministry of Light Industry present. The meeting summarized briefly the whole of the foregoing report and also considered the best approach to the work in 1979. Great emphasis was laid on co-operation and contact during the intervening time.

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