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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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DEVELOPMENT OF NON-WOVEN TEXTILES *

SI/HUN/74/809

HUNGARY

Technical report: Selection of machinery for two new non-woven lines and one experimental 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 NATIIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna

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Explanatory Notes

The non-woven industry uses a lot of specialized terms not used in other sections of the textile industry. However, it is thought that all the terms used in this report will be understood by anyone with any contact with the non-woven industry.

The following abbreviations are used:

to	metric tonnes
m/min	metres/minute
g/m2	grams/square metre
mill m2/year	million square metres/year
rev/min	revolutions/minute
Ft	Forint
Ft/m2	Forint/square metre
P/kg	Pence/kilogramme
mill. kg	million kilogramme
d-tex	decitex - a measure of fibre fineness
l/m2	litre/square metre
Lŏrinci Lŏrinci T.V.	Lŏrinci Textilipari Vållalat, Budapest

ABSTRACT

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

The project "Development of Non-woven Textiles" (SI/HUN/74/809) was divided into two phases. The first phase was completed in October 1977 and the report was presented in November 1977 (DP/ID/SER.A/152). The first part of the second phase was completed in October 1978 and the report was presented in February 1979 (DP/ID/SER.A/183). The present report covers the final part of the second phase.

A number of quotations have been considered for a versatile line to make non-woven fabric in the range 15-60 g/m2. Many of these were discarded on either technical or economic grounds. From the remainder five quotations were selected for a full economic and technical analysis and on the basis of this analysis a final recommendation has been made.

A number of quotations for a spray bond line to produce fabric in the range of 50 - 200 g/m2 have been considered. Again a technical and economic analysis has been made, but due to the lack of complete data only preliminary recommendations could be made.

Several possible solutions for an experimental non-woven line have been considered, and a solution combining a production plant with experimental machines has been proposed.

A survey has been made giving a general picture of recent developments in non-wovens in Western Europe and making some attempt to predict future developments. It is intended that this survey will be published in the Hungarian Textile Journal.

A brief report about some experimental work at Lőrinci T.V. has been prepared.

A number of suggestions have been made concerning new products which could be made on the Malimo, Maliwatt and Malipol stitch bonding machines.

A brief report has been made about problems connected with the effective use of Hungarian wool in the worsted industry, with suggestions for further work.

A report has been prepared to analyse the technical and economic performance of Lőrinci T.V. in comparison with a similar firm in Western Europe.

A recommendation concerning the use of a scholarship has been made and a list of suitable non-woven firms has been prepared.

Introduction

Project Background

The non-woven line commissioned in 1977 is now running at its planned capacity (7 mill m2/year) but it is still found that the demand is greater than the supply. Furthermore, a new demand for about 20 mill.m2 of coverstock is expected in 1980/81. To meet these two demands a new versatile line is planned and also the possibilities of establishing an experimental line and a new spray bond line are being investigated.

Objectives of the mission

The major objectivesof the mission were to advise Lőrinci T.V. on the selection of equipment for the three new lines mentioned above. A secondary objective was to try to find new products and uses for the stitch bonding machines, which in some cases were standing due to lack of orders. A third objective was to pass on the most recent information about non-woven developments in Western Europe to the people in Hungary working in the non-woven industry.

I was also requested by the Ministry of Light Industry to prepare a special report criticising all aspects of the working of Lőrinci T.V., organizational, technical and economic. The Ministry also asked me to study the problems existing in the Hungarian wool industry.

Method of presentation

In view of the many different objectives in this particular mission, many of which are quite unrelated, it has been decided to depart from the usual presentation and to write a separate chapter about each objective. Where applicable the recommendations in each chapter will be indexed separately.

Contents

Content (cont'd.)

Content (cont'd.)

CHAPTER 1

Choice of machinery for producing 15-60 g/m2 fabric

1. General

It is assumed that the primary purpose of this line is the production of coverstock weighing 15 g/m2 but since it is unlikely to be able to use this full production of coverstock in Hungary and it is dangerous to rely on export it is assumed that the line must also be capable of producing other fabrics, probably in the range 30 - 60 g/m2.

Coverstock lines are normally very simple and are kept running continuously on the one product. Coverstock can therefore be made very cheaply and it is important that the proposed plant should be kept as simple as possible to keep the product competitive. For this reason it is my opinion that the number of bonding methods should be a maximum of two, possibly only one.

One other important consideration is the balance of supply and demand on a world scale. Recently the total possible production of coverstock has been slightly in excess of the demand and furthermore several new plants have been built. However, the total demand for coverstock is increasing at a rapid rate at present, so the imbalance will probably not continue. Also it is possible to regard Hungary as an isolated unit, in which the new production of coverstock will satisfy the new demand. However, the world supply position and the world price are important, because it may possibly be wiser to buy rather than produce.

2. Methods of Manufacture

Quite large quantities of coverstock are made by the wet-lay method and a certain amount by the spun-bond method. The new coverstock made by Courtaulds from fibrillated polyethylene is also worth mentioning. However these methods produce on an extremely large scale and since it would not be wise to plan a plant relying on large exports these methods need not be considered further, except in so far as they affect the world price of coverstock. The only possible method in Hungary is the dry-laid method and the main decision is which bonding method to use.

There are a number of general considerations concerning the method of bonding. Firstly, the fabric should be soft to the touch and also drapeable in order to give reasonable comfort in use. Drape and handle are difficult to measure objectively, but fabric thickness can be measured easily and relates to some extent to these properties. It is suggested that 15 g/m2 fabric should be thicker than 0.1 mm, otherwise the fabric feels stiff and papery. Secondly the coverstock must have good wet strength, particularly in the cross-direction, in order to prevent the pad breaking open in use. A suggested minimum value here is 160 gf on a 25 mm strip.

A survey has beer carried out on 36 coverstock fabrics made all over the world. The results are summarized below; the handle was judged subjectively.

Method of manufacture	No. examined	Handle		
		Poor	Average	Good
Impregnation	11	5	3	3
Hot callender	6	1	3	2
Print bond	10	2	5	3
Point bond	2	-	2	-
Wet laid	3	1	1	1
Spun bond	2	1	1	-
Expanded film	2	1	-	1

Besides these general considerations a number of trends should also be noted. Firstly, there is a tendency for the pad manufacturers to use so-called dry-liners made from polyester or polypropylene rather than rayon. Although these fibres can be bonded by any method, thermobonding is almost certainly the cheapest. Secondly there has been a serious suggestion that in the future medical regulations regarding the use of synthetic binders to be used in contact with the skin may become more strict perhaps even leading to a total ban. Obviously this is a response to the current mistrust of chemicals and is a matter of opinion. For example a Swedish dermatologist has stated that in many tests he has never observed a commercial non-woven fabric that caused any irritation to normal skin. On the other hand Courtaulds are advertising that one advantage of their newest coverstock is that it contains no synthetic binder. Once again this leads to a preference for thermobonding rather than synthetic binders.

2 a) Impregnation

As seen in the table above impregnation is the most common method for producing coverstock. Provided that the foam method is used and the binder is quite a soft one, a very satisfactory coverstock can be made. This method is also suitable for the heavier weight fabrics, so there is no doubt that this method should be used.

2 b) Hot callender

This method can produce good results in a blend with Viscose/ Polypropylene. It also has advantages in allowing home-produced polypropylene to be used as the binder, rather than imported acrylic binder. However, it seems to me that this method is less useful for the heavier weight fabrics. It also has the disadvantage of lengthening the line and making it more complicated. I am therefore slightly against this method as the second way of bonding.

2 c) Print bond

As seen in the table on page 8) this is a very common way of making coverstock and can produce some very soft fabrics. It is also of some use in making surgical gowns, drapes, etc. and semi-durable dusters and cleaning cloths in the heavier weight, though it has to be admitted that Lőrinci T.V. have had no success in selling print bonded fabrics up to now. One important consideration is that print bonding and foam impregnation can be combined together in a very simple way. I am therefore slightly more in favour of this method than hot callendering.

2 d) Point bond

Although two coverstocks are made by this method I think that it will be very difficult to achieve the required strength in the cross direction. I would not recommend it as a general method, but if hot callender is finally chosen, then it would be useful also to have a point bond roller.

3) Detailed consideration of the various quotations

a) Babcock - Hergeth

i) Opening and mixing

The use of a waste hopper is considered desirable, but the long term mixing is considered excessive (Hergeth No. 16195) and has been omitted in the costing calculation (300,000 DM before customs);

ii) Carding

This type of card gives an excellent random web, which aids the cross direction strength. It is important to have it demonstrated with fine dtex fibres at high production rates. Since the card is claimed to give weights up to 100 g/m2 it would be worthwhile discussing the use of one card instead of two. This would give a saving of 700,000 DM before customs.

iii) Pre-bonding

This is an expensive addition to the line, both in capital cost (300,000 DM before customs) and in the additional drying costs. It should make the line easier to run, but it would be worth discussing if it could be omitted.

iv) Drying of pre-bond

The infra-red dryer should help in making a softer product.

v) Impregnation

It is not clear if two-sided foam impregnation is possible. It should be included for the heavier weight fabrics. In my opinion the rubber covered roller will give better penetration and a lower foam/fibre ratio than the Mohr impregnator on the first line. This should be checked.

vi) Printing

The printing roller is built into the impregnating unit, which seems an excellent idea,making the plant simple and neat.

vii) Drying

Standard cylinder dryer, all Teflon coated.

viii) Cutting

No cutting was included in this offer and an estimated price of 200,000 DM before customs has been assumed.

General

This plant is one of the best general purpose lines and the costing calculation shows the fabric to be competitive and allows some profit. The quoted minimum weight of 20 g/m2 needs discussing.

b) Mohr offer (foam impregnation and drying only)

i) Impregnation

The impregnator uses two metal rollers and seems identical in design to the one on the existing plant.

ii) Drying

Hot air dryer followed by cylinders. This should enable a more open fabric to be produced.

General

Although the dryer is good, I do not consider the design of the impregnator to be good. Also I would prefer to buy one single line, rather than a series of parts, so I recommend that this offer should be turned down.

c) Hergeth offer 15738

This was an early offer and contains print bonding only. This would severely limit the range of products, so I recommend that this offer should be turned down. It is interesting that it uses only one card (see a) above).

d) Hergeth offer 15737

This was an early offer and contains only hot callendering. For the same reasons as c) above, it is of no further interest.

e) Hergeth offer 15739

This is an early offer including a cross-lapper and is of no interest at all.

f) Duotex 7233

This offer is technically quite sound for producing coverstock by hot callendering only. However it is not particularly cheap and the method of bonding would lead to serious limitations in the range of products. It is recommended that this offer is turned down.

g) Duotex 7234

This plant consists basically of two cards with foam impregnation, an infra-red dryer and cylinder dryers. The infra-red dryer (burning gas) would help to improve the handle of coverstock.

Although there is only one system of bonding, it gives a very wide range of possible products, so I consider that this offer should not be rejected immediately. The following drawbacks would have to be corrected.

i) provision of blending and waste hoppers;
ii) provision of some randomising arrangement on the cards;
iii) application of foam from both sides.

h) Brückner, Spinnbau, Temafa

i) Blending and opening

Satisfactory with the addition of a waste hopper, which has been added into the cost calculation.

ii) Carding power

The card produces a random web, but has only 9 workers so a careful trial would be needed to check the opening power on fine dtex fibres.

iii) Hot callender

At present this is only quoted as a point bonding unit. It should be checked whether the pressure is adequate for area bonding using the smooth roller.

iv) Print bond and dryer

Quite normal, but with no pre-dryer.

The advantages seen with this plant are

- the possibility of two methods of bonding;
- the use of the hot callender as a prebonder before the second bonding.

The alterations needed would be

- alter point bond to area bond;
- alter print bond to foam impregnation;
- addition of a waste hopper.

The main disadvantage is the high price, which is due to the following factors:

- the Temafa opening and blending system costs 375,000 DM compared with

Hergeth	DM 208,000
Duotex	DM 300,000
Tessiltechnica	DM 140,000
Trützschler	DM 160,000

- the hot callender costs 700,000 DM compared with Ramisch 430,000 DM, though the Brückner does include one smooth and one point bond roller.
- two wind-up units are required on this plant at an extra cost of 230,000 DM.

The high price of the plant is reflected in the high cost of the coverstocks calculated. Only two fabrics could be made at a profit according to these calculations. In my opinion this plant is too expensive.

i) Matex France RP 0364

This plant is capable of impregnation or print bonding. The price also includes know-how from Intissel. However the weight range is only 17-30 g/m2, the samples submitted were not particularly good, almost no plant details were given and the plant was even more expensive than h) above, so it is recommended to refuse this offer.

j) Tessiltechnica 73209

This plant has no advantages over plant k) considered below, so will not be discussed further.

k) Tessiltechnica 73280

This plant is a very simple one for producing coverstock only by simple liquid impregnation.
The major disadvantages are that cotton cards are used, giving high fibre orientation and low cross direction strength. Cutting is done on the line with a minimum width of 150 mm, which is just adequate for Rico Vàllalat at present.
The costings show that very substantial profits could be made selling at world prices. I would therefore recommend the purchase of this plant except for the fact that it produces about 35 mill. m2/year and the estimated demand in Hungary is only 20 mill. m2/year. The market in coverstock is very competitive and it could be difficult for a small firm to sell what is a relatively small quantity in this market. However, according to the figures there is a very considerable price advantage and it would be worth discussing with Hungarotex if they could sell it.
As an alternative it is possible to divide the Tessiltechnica line into two and make just about enough for the Hungarian market. The costs are slightly higher but this would avoid the risk of being forced to export.

1) Kleinewerfers 11,348/78 (Trützschler and Jennes)

i) Opening and blending

A waste hopper has been added to the calculated cost. I am doubtful if there is enough long-term mixing. The chute feed claims to have an autoleveller but the figure of F 7½% weight variation is not very good.

ii) Carding

I have never heard of Jennes cards, but I do not think it should be necessary to use 3 cards to produce 60 g/m2. Also the cards do not give random web. If this offer is accepted I recommend the cards be changed to Hergeth or Spinnbau.

iii) Hot callender

At present this is quoted as a point bond callender. A check should be made if the pressure is great enough for area bonding. The production is reduced by the speed of this callender (30 m/min.). It is worth discussing if it can be increased.

iv) Foam impregnation

It is important to check that impregnation is possible from both sides and that the squeeze rollers can be set to give a low uptake of foam e.g. 250% on the web weight.

The production has been calculated as though the foam bonding also ran at 30 m/min. because no other figure was available. It is worthwhile asking if this speed can be increased.

v) Print bond

Print bonding is possible but it appears to be necessary to pre-bond with the hot callender first. This unit would be most interesting if pre-bond were not needed and it would be worth asking if it is possible.

vi) Drying

This plant has a hot air pre-dryer but only the first cylinder of the dryer is Teflon coated.

This plant has the major disadvantage of unknown,non-random cards.

There is also the important question remaining unanswered of how the heat-bonded fabric reaches the wind-up position.

The cost calculations show this to be quite an expensive plant, but this is partly due to the low speed referred to above.

It is important to note from the costing that an increase in width from 2.0 m to 2.5 m reduces fabric costs very significantly by 12 filler/m2. This will be approximately true of all plants, except for Tessiltechnica of course.

m) Cutting

I believe that cutting should be done off the line, though some plants do cut on the line. This is because with a large number of knives, knife adjustments and knife failures will severely limit the plant efficiency.

Rico Vállalat state their requirements as being rolls of 600 mm diameter and in widths of 140 mm up to 280 mm. However I believe the cutting plant should be designed to cut down to 100 mm in case at a later stage mini-pads are made.

Recommendations

I think three cases should be considered.

Case 1

Rico Vállalat can place a firm order for 20 mill. m2/year.

I think there is a strong case for buying the smaller Tessiltechnica plant. It is possible to make a true profit of up to 80 filler/m2 i.e. a total profit of 16 mill. Ft/year (see Appendix 3).

Case 2

If it is expedient to combine coverstock production with an experimental line.

In this case either the Hirag plant (see later) or the Duotex line should be considered. The choice should depend on price obviously, but also on which can make the most random web. Unfortunately I am not able to check either of these points.

Case 3

If it is decided to buy a versatile bonding line with two methods of bonding.

In this case there is no doubt that I would recommend the Babcock-Hergeth line. Both the Brückner, Spinnbau, Temafa and the Kleinewerfers plants are too expensive and need further modifications before they could be considered satisfactory (see Appendix 3).

With the Babcock plant it will be possible to make a small profit when making coverstock, but hopefully a larger profit on other materials.

It is my opinion that Case 2 is the most sensible one, since Case 1 requires an immediate demand by Rico for coverstock and all the plants in Case 3 are too expensive for a reasonable profit to be made.

CHAPTER 2

Choice of machinery for a spray bonding line 50-200 g/m2

In this case only one complete offer (Temafa, Fehrer and Mohr) has been received, so comparisons will be made section by section.

1. Opening and mixing section

I assume that the fibres being blended will be fairly similar in physical properties, so that complete uniformity of blending is not too critical.

The unit should consist of two weighing hoppers, one waste hopper, a hopper feeder and a fine opener.

Estimated costs are:	Temafa (without oiling system)	DM 408,000
	Hergeth	DM 250,000
	Duotex (with large mixing plant)	DM 350,000
	Tessiltechnica	DM 150,000
	Trützschler	DM 200,000

Under normal circumstances I would recommend either Hergeth or Trützschler for reliability combined with price. However Lörinci T.V. already have a Temafa plant which is very satisfactory, and it would be convenient for spares, familiarity, etc. to continue with Temafa. In spite of this it seems to me that Temafa is really too expensive and it should be decided to standardize on either Hergeth or Trützschler for this line and the experiment/light-weight line.

2. Fibre batt preparation

Here there is a choice between a Fehrer V21/K12 2.6 m wide costing 5,040,000 Ö.Sch. and a D.O.A. card and airlay machine 2.4 m wide costing 3,816,000 Ö.Sch. Other airlay machines are American and are now very old-fashioned in design.

The advantages of the Fehrer are:

i) A Fehrer K12 is already installed in Lörinci T.V. It gives very good results, but the fibre is pre-carded at present, whereas this design does not include pre-carding.

ii) The Fehrer machine is better designed from an engineering point of view. The advantages of the D.O.A. machine are

- more opening power than the Fehrer;
- the D.O.A. machine is better designed from a textile point of view.

Unfortunately D.O.A. does not state the recommended production rates, so a direct cost comparison cannot be made.

I do not believe that the Fehrer V21/K12 arrangement would give sufficient fibre opening or a sufficient even batt at 50 g/m2, so would recommend the D.O.A. machine, provided that the production figures are satisfactory.

3. <u>Spray bonding and drying</u>

The choice is between a Mohr unit running at 20 m/min. with 4 airless sprays and an 8 m dryer costing DM 632,000 and a Charvo unit running at 15 m/min. with 6 airjet sprays and a 8 m dryer costing DM 539,000 but not including a wind-up unit.

a) <u>Type of spray</u>

I am sure that either firm could provide either type, but it is significant that each firm has chosen a different type. There are a number of advantages of each type including

- degree of filtering needed to prevent jet blocking;
- drop size and penetration into the fabric;
- amount of wasted spray solution;
- degree of disturbance of the fibre batt.

I suggest further discussions and/or trials to decide which system is best.

b) <u>Spray cabins</u>

Both units have suction units under the sprays, but the Mohr has a cleaning unit to clean the conveyor.

c) Dryers

Both dryers are the same size, but they specify temperatures far higher than the steam temperature at Lőrinci. However the heating capacity quoted for the Mohr dryer seems to be far in excess of the drying capacity needed. I think the following questions require answering:

- whether to use airjet or airless sprays;
- cost of a cleaning unit on the Charvo;
- the actual drying capacity of both dryers supplied with steam as at Lőrinci;
- the spray traverse speed of Charvo (at the present time the Charvo with 6 sprays working at 15 m/min. fabric speed seems to give far better coverage than Mohr);
- the cost of a wind-up unit for the Charvo line;
- why Mohr has been quoted with Thermal-oil heat transfer? Presumably direct steam heating would be cheaper.

4. Recommendations

It can be seen that a number of questions remain to be answered but my opinion at the present time is

i) a Hergeth opening unit, on the grounds of price;

ii) a D.O.A. airlay unit due to the better fibre opening;

iii) a Charvo spray unit on the grounds of reputation and the apparently lower price.

CHAPTER 3

Choice of machinery for an experimental non-woven line

I agree that the time is right to establish some form of experimental equipment in the non-woven section and the idea of having a plant situated in Lőrinci T.V. to be used by the Textile Research Institute to serve both Lőrinci T.V. and Temaforgs and also to be used by Lőrinci T.V. for full-scale production, is a good one. However, I think it is very important indeed that very good and friendly agreements should be made regarding such details such as:

i) repairing, maintenance and cleaning of the plant;

ii) which company has ultimate control of the plant;

iii) time-sharing arrangements between the Institute and Lőrinci T.V. and circumstances when the timetable can be altered, e.g. a rush order or a complete lack of orders from Lőrinci T.V. may make an alteration desirable and similarly in the case of the Institute;

iv) very careful metal detecting systems will be required when waste is run on this equipment, otherwise the machinery could be ruined for processing fine dtex fibres.

1. Consideration of line width

There are basically two possibilities:

i) a line 1 m wide.
This would be a good choice for the Research Institute but the costings given earlier show that it is impossible to run such a machine economically in production. Since the plant will spend about half its time on production I think a 1 m wide plant is out of the question. It should also be noted that the 1 m plant is only slightly cheaper than the 2.2 m plant.

ii) a line 2.2 m or 2.5 m wide (preferably 2.5 m)
Conversely this plant would be very suitable for production but would consume fibre rather too quickly for experimental work. However, it is possible to edge-trim fibre batt before bonding, so it is suggested that similar knives be set to cut the batt at 1 m wide for experimental purposes and the wide edges be returned either manually or by vacuum to the waste hopper.

It is also noted that the Fehrer K12 and the needleloom will interfere with the smooth running of the plant when producing 15 - 60 g/m2, both for the Institute and especially for Lőrinci T.V. It is therefore recommended that these two machines be taken out of the line and be purchased 1 m wide with some cost saving. This will give greater flexibility because the Fehrer K12 can then be fed with 60 g/m2 material from the experimental line (possible to wind up simply with a paper separating layer), with several thicknesses of 60 g/m2 material, or, by arrangement with Lőrinci T.V., with cross-lapped web from the other line.

The important advantages of this configuration are

- simplification of high speed running of 15 g/m2 material;
- greater flexibility in running the Fehrer K12 and the needle loom. It should be quite possible for instance to build up a stock of batt for feeding the Fehrer K12 so that the Institute could work on the Fehrer K12 and the needleloom and Lőrinci T.V. could produce on the rest of the line, simultaneously, giving a very big financial saving.
- a small cost saving in buying the Fehrer K12 and the needleloom narrower, but this is not very important.

Consideration in detail of the experimental plants

In total 16 experimental plants were submitted but I have only had the opportunity of looking at the one selected by the Institute as being the best, that is the one submitted by Hirag.

Hirag Plant

a) The present plans do not contain any blending equipment, but rely on a store being built up by the existing blending plant, which would then be used to feed both lines. However, this would mean either manual feeding from the store to the line, which is wasteful in labour or would require automatic feeds making the system more expensive than a new opening line.

It is therefore recommended that a new opening and blending line be purchased. Rough costs from the different manufacturers have been given earlier. There are advantages in using Temafa (similar spares, familiarity with equipment andprevious satisfaction with this equipment) but it is the most expensive. Otherwise use Hergeth or Trützschler (as specified in the offer) though it can be argued that cost savings here are minor in comparison with the whole plant.

b) Carding. The carding is by Hollingworth Mastercard.
There are two aspects of this card which should be investigated.

i) does the Webmaster system of removing the web from the doffer give sufficient randomisation? If the fibres are too parallel it will be difficult to achieve the required cross direction strength;

ii) will this card give good quality web at 60 g/m2 using the fine dtex fibres likely to be used?

Perhaps the aspect of fibre breakage on the longest fibres likely to be used should also be investigated.

Too few details of this card are available at the present time.

c) Impregnation

Very few details are available here but is is important to ensure that

i) foam can be applied from both sides;

ii) it is possible to impregnate with a low foam pick-up. If it is possible to negotiate here it would be an excelle t idea to specify the Artos-Babcock or Kleinewerfer plant, which would allow both printing and impregnation. The cost does not seem to be very much greater than foam impregnation alone, e.g. Babcock combined plant DM 245,000, compared with Brückner DM 231,000 for print bond alone. However the combined printing/impregnating units both seem to require pre-bonding, so this may not be possible.

d) Drying

The suction drum dryer is extremely small and neat, and the air drying will give a good handle.

It is important to check that the air speeds required do not distort the lighter weight fabrics, or cause marking of the fabric from the pattern on the drum. It is doubtful if the stated evaporation rates could be achieved with the steam temperatures available at Lőrinci. Gas heating may be the answer but the economics of this need to be checked.

e) Auxiliary units off the main line

The use of an airlay machine and needleloom in narrow width off the line is recommended. However it should also be pointed out that the plant does not include print bonding (unless it can be included under c) above) nor does it include a hot callender or point bonding. I recommend that a small hot callender with interchangeable rolls, such as the 200 mm wide model made by Ramisch-Kleinewerfers should be purchased. Also printing facilities should be provided for the experimental section, for instance it might be possible to take the print unit from the first line, but a dryer would also be needed.

3. Recommendation

As mentioned previously the combination of an experimental line with the production line seems to be the most feasible scheme. In that case the Duotex production (No. 7234) unit should also be considered for the experimental line.

The Hirag unit is much neater than the Duotex one, but even so I think the decision should be made on the basis of

i) which makes the most random fibre arrangement (e.g. measure ratio of machine to cross direction strength);

ii) performance of foam impregnator and especially if a print bond unit could be included;

iii) dryer performance in relation to fabric appearance and handle;

iv) price.

CHAPTER 4

Survey of non-wovens in Western Europe

1. General

At the present time the non-woven industry is in a strong position, with a predicted annual growth of 5 - 8% (or 8 - 10% in another prediction) in Western Europe compared with a growth in the whole economy of 2 - 4% and a zero or negative growth in the textile industry. In the USA the actual growth has been lo - 15% in recent years and this is expected to continue. The other major production area is in Japan, but no figures for expected growth are available. The current production figures in Japan are given as 400 mill. m2 dry laid and spun bond and 70 mill.m2 wet laid. Of this 100 mill. m2 is used as interlining (80% fusible). These figures seem rather small compared with the table given below; the difference is probably caused by the different definitions of non-woven.

It should be stressed that all these predictions were made before the recent oil price rise. However the last big price rise in 1973 only affected production for one year due to the general world slump and since then growth has continued as before. It would seem that non-wovens in general are not only cost effective but also energy effective (due to the high energy required in spinning), so that in the near future the non-woven expansion will continue. After 1990 it is too difficult to predict.

Since the expansion of non-wovens is greater than the economy as a whole, non-wovens must continually find new end-uses. The general view is that the new end uses can be found using slight modifications to existing manufacturing processes. Although radically new processes will continue to be found, they cannot be relied on to produce the increases in production.

For interest the world distribution of non-wovens by weight and the EEC distribution by end use in 1978 is given on the next page.

TABLE 1

Country or area	Total production (all methods) mill. kg	Total number of dry-laid lines (chemical bond) only
USA	340)	245
Canada	13)	
South America	11	22
Western Europe	140	185
Eastern Europe	41	48
Far East and Australia	68	68
Middle East and Africa	5	14
China	11	22
	629	604

TABLE 2

EEC only	Total weight in each end-use (mill.kg)
Interlinings	8.2
Other clothing	1.5
Cleaning and wiping	8.2
Medical and sanitary	23.7
Coating substrates	4.1
Furnishing and household	11.2
Filters	8.1
Papermakers felts	7.1
Other industrial	9.6
Needleloom carpet	62.6
Carpet underlay	5.7
Carpet backing	2.4
Total	152.4
plus spunbonds - use unspecified	48.0
	200.4

The big difference in total between Table 1 and Table 2 is probably caused by some difference of definition, e.g. needeloom carpets may be omitted from the first table.

2. Use of fibres and new fibre developments

The present use of fibres in the EEC is given below.

TABLE 3

Use of fibres in EEC non-woven industry (mill. kg)

Rayon	58	
Nylon	29	
Polyester	39	
Other (mainly polypropylene)	30	
Cotton	9	
Wool	10	
Total	175	of which 167 is dry-laid, 8 is wet-laid

Current fibre prices in UK are:

Rayon	61 p/kg
Polyester	50 - 84 p/kg
Polypropylene	87 - 95 p/kg
Nylon	106 -130 p/kg.

The wide price range is due to overcapacity and the possibility to buy substantially below quoted prices.

The current trend is for rayon usage to remain steady, nylon to fall and polyester and polypropylene to increase by about 8 mill. kg/year each. In the USA the trend is very similar, except that there nylon only represents 3-4% of the total.

Special rayons

i) Courtaulds Viloft is a hollow rayon with a high modulus, intended to simulate cotton. It is available with a glycol finish for absorbent uses (medical/sanitary) but the price (74p/kg) is considered too high for this use. A similar fibre is made in the USA.

ii) A special rayon with 50% more absorbency is being made in the USA and by Courtaulds. Probably both fibres contain pores.

iii) A special rayon with better cohesion for high speed carding is being developed by Courtaulds.

Special Polyesters

i) Two US firms are making hollow fibres especially for spray bond uses. Dupont also makes a hollow self-bonding fibre (either bi-component or possibly a fibre blend);

ii) Grilon make a special polyester for wet-lay, easily dispersable.

Special Polypropylenes

i) Bicomponent polypropylene/polyethylene fibre with assymetric cross-section  made in Japan;

ii) Hydrophilic polypropylene made in Denmark;

iii) Short fibrillated polypropylene made for wet-lay.

Other fibres

i) Sea-Island fibres  are produced in Japan as a means of processing very fine fibre (0.1 dtex) as a bundle, then dissolving the "sea" away;

ii) Very high absorbency fibres are made from carboxyl methyl cellulose especially for disposable nappies, absorbent pads, etc. Fibres are 3 mm long like cellulose fluff, but powder is thought to be more cost effective;

iii) Epitropic fibres (carbon coated) are being used in filters to prevent sparks due to static (especially coal mines, inflammable gasses, etc.)

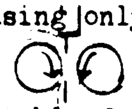
iv) Bayer are making an acrylic fibre with pores to give absorption.

3. New products

Several of the most important new products are spun bonds intended for the medical/surgical market. Following the viscose spun bond made by Mitsubishi in Japan, which is also made in heavier weights for interlinings and even civil engineering, a cuprammonium rayon has also been developed in Japan by Asahi Chemicals. Courtaulds have very recently brought onto the market a dry-liner type coverstock which is made by extruding polypropylene as a foam then stretching it in both directions to fibrillate it and finally bonding, probably by the point-bond method. The material is called Novoweb and is being made at the rate of 25 mill.m2/year. Courtaulds are also developing a viscose spun bond for wipes, coverstock, surgical gowns, etc. The fabric is not in production yet but a small sample of about 30 g/m2 appeared very uniform, but rather too paper-like.

An interesting new fabric is being made in the USA (Maralay). A special air lay machine is fed by card sliver and produces a patterned fabric (checks and stripes). However the use of this fabric is not known. Another new fabric (Vivelle) is made by passing polypropylene film through a hot callender so that the film melts and the surface is lifted into a great number of short fibres. It is used as a very cheap velvet and for wall coverings.

Carpet backing for tufted carpet has been made for some time by needling a layer of nylon fibre onto a woven polypropylene. In a new method which is probably cheaper than needling the nylon fibre is attached by a hot calender.

Heuer (W. Germany) have made a type of machine for perforating fabric with heated needles. The machine is claimed to give little fibre damage and produces an effect similar to Johnson and Johnson fabrics (improved drape). I have not heard of anyone using one yet. Another needling machine is designed to needle along the fabric, instead of through it, by using only one line of needles working between the nip of two rollers.  The fabric is dense at the centre but loose on the surface, suitable for some forms of dry filtration. Again I don't know anyone using the machine.

Non-woven fabrics (needled and spraybond) now have 80% of the dry filtration market, but almost none of the wet filtration market. The reason has been that the fibrons surface of the non-woven prevented the release of the wet solids (cake release). Now needled non-wovens from nylon, polyester, polypropylene, Nomex and Teflon in the weight range 250 - 900 g/m2 are being hot calendered to give an almost continuous "skin", which is smooth and therefore gives good cake release.

4. <u>New uses for existing products</u>

One major new use is in horticulture. Several firms are producing capillary matting to make watering in greenhouses automatic. The total EEC market is 20 mill.m2 sold at 23-30 p/m2 (£ 5 m). Fabric weights are 200 - 300 g/m2; the Freudenburg product is bonded and holds 4 l/m2 with a capillary rise of 40 mm; Low Bros. make a needled product holding 3.2 l/m2 with a capillary rise of 52 mm. Other greenhouse products are spun bonds for shading the plants from strong sunlight and as "blackout" material for artificially shortening the length of the daylight. Rather thicker spunbonds (60 g/m2) are being used for greenhouse insulation, more advanced forms being metallised to cut down radiant heat loss.

In agriculture 500 to/year of non-woven fabrics are being used for milk filtration, some dry-laid, some wet-laid. There is also a revolutionary idea for using non-wovens as bedding for cows. It is claimed to be cheaper than straw, since it can be hosed down and used continuously, but I do not think that it is used much yet.

Despite many years development work ICI point bond fabric achieved little success. However, in a printed and raised form it is now being used as car seat covers by Chrysler, UK.

Following the tanker disasters round the coast of Europe there has been a lot of research into ways of removing the oil from the sea. One method uses a needled polypropylene belt weighing 700 g/m2. The fabric selectively absorbs oil, can be squeezed and returned to the sea in a continuous cycle.

Minor uses:

i) Display fabrics for shop windows - made from fire retardant rayon for greater safety;

ii) Calendered carpet backing fabric described above - also used in upholstery, e.g. undersurface of chairs, etc.;

iii) Use of Tyvek as waterproof cover with foam and metallised film laminated together to give a fabric for making survival garments, e.g. North Sea oil rigs, cave and mountain rescue, etc.;

iv) Wet laid and spun laced fabrics used as inner linings for mattresses;

v) US disposable nappies - using dry liners difficult to tell when nappy is wet. Outercover is made from a plastic with a printed design which shows up more clearly when surface below is wet;

vi) Use of polypropylene spun bond to reinforce asphalt on airport runways, where cracking was a serious problem due to weight of planes, weather, etc.;

vii) Freudenburg car wiping cloth - made more absorbent by pores in the binder; these are made by salt crystals in binder which are later dissolved;

viii) Big demand in US for wiping cloths with some pre-treatment, e.g. polish, deodorant, de-misting fluid, Eau-de-Cologne, etc. Fabric either wet-laid or dry-laid disposable.

5. Use in civil engineering

The use of non-wovens in civil engineering is expanding rapidly, inspite of the fact that the civil engineering industry itself is suffering from a lack of capital expenditure. Major uses are as foundations for new roads, as stabilisation to prevent shearing in soil dams and embankments and stabilisation of river banks and sea coasts. The properties required are filtration, strength, resistance to rotting and in some cases high surface friction. The five types of fabric being used are:

- spun-bond polyester and polypropylene hot calendered;
- polyester and polypropylene chemically bonded;
- woven polypropylene tape - but has low friction;
- woven polypropylene tape with fibre needled to surface - this material has a higher surface friction;
- a needled felt (300 - 400 g/m2) either dry laid or spun bond.

A recent development is the use of a heat bond nylon mat to reclaim land suffering from erosion. The mat is spread and is then seeded.

6. Coverstock and medical uses

There was a growth rate in this area of 25%/year from 1970-1976 in EEC and a big growth rate is still predicted for the present year. However, there are now many plants, including wet-laid which specialize in this product, so that prices and profits are very low. For instance US production was 1,800 m m2/year and sold at 2.6 p/m2 = 1.9 Ft/m2. The most modern plant described is a Finnish one using 1.5 - 2.5 dtex fibre making 16 g/m2 fabric 2m wide at 160 m/min. The possible production is about 140 mill. m2, but in fact it produced only 75 mill.m2.

In terms of properties there is a tendency for the users to require heat-sealable fabrics, because they are easier to make-up. There is a strong swing away from rayon towards polyester and polypropylene, since this gives a dry-liner, which is also heat-sealable and also, as seen above the price difference between these fibres is relatively small. It has also been suggested that it may be more difficult to use binders in medical fabrics in the future, due to the growing ecological opinion particularly in the US.

In a survey of US hospitals it was found that non-wovens were used in the following cases:

95% used some caps, underpads and masks;

85% used some nappies and shoe covers;

50% used some surgeons gowns and Operating Room/O.B. packs;

35% used some drapes;

30% used some towels.

For the sterilisation of disposable nonwovens in the USA, 60% is done by ethylene oxide but some is done by radiation including the use of electron beam sterilisation.

Disposable nappies cost on average £ 2-30 per week (100 Ft/week) in USA but a nappy service (supply and cleaning, collection and delivery) costs between £ 2-50 and £ 3-40 (110 and 150 Ft), so the disposables are still competitive. The coverstock represents 15% of the cost of the disposable nappy.

In the production of disposable nappies manufacturers are still uncertain whether to use superabsorbents or not. Powder at a cost of £ 3-00/kg is cheapest but fibres and films are also available. There is obviously a saving in bulk when superabsorbents are used, so the use tends to be confined to geriatric pads and premium quality nappies.

7. <u>Dry-laid process</u>

A new type of machine for pulling waste into fibres is available. Production rate is up to 400 kg/hr and the principle is basically the same as the Hergeth random card. Dupont are reported to be using a new type of air lay machine using some form of roughened roller instead of card clothing. The Angleitner method of feeding directly from a card to an air-lay machine seems to be a new idea. A production rate of 20 m/min. at 55 g/m2 is claimed (132 kg/hr at 2 m wide). The most modern Asselin cross-lapper is simpler and cheaper than the former model, but still retains direct contact with the card web all the way through. They claim to have sold 50 in two years.

The following new plants have been publicised, but probably other plants have been installed:

5 plants by Hergeth for Russia based on the spray pre-bond principle. They seem identical with the Babcock /Hergeth offer (20-70 gsm);

1 plant by Hergeth in Yugoslavia, print bonding for coverstock;

1 Italian plant consisting of two cotton cards, impregnating and cylinder dryers to make 16 g/m2 coverstock 1m wide at 50 m/min. (50 kg/hr);

1 powder bonding line sold by Air Industries to Sweden. The fabric weight was given as 25-30 kg/m2, but this may be a misprint.

In the bonding agent area Rohm and Haas have two new modifications. The first are two new bonding agents which are hydrophilic to give better absorbancy. The second is a range of acrylic binders which coagulate due to a pH change. They claim that the resulting reduction in migration leads to higher fabric strength. In the USA experiments have been made to develop a binder which would cure with radiation, as a means to help the energy problem, but there were no results.

It was interesting to note that the Americans have found it difficult to control a plant with many manual controls, because the operatives could not be prevented from making continual alterations. They have concluded that the only solution is to have more automatic control.

8. Wet-laid process

A dry-laid process has been invented which is claimed to give the same production rates as the wet-laid process (500 kg/hr) but with a smaller machine.

If the machine has no problems then it is a most important discovery, but unfortunately similar claims have been made before with no results.

The following new plants have been announced:

2 plants for glass fibre at 4m wide running at 125-200 m/min. on fabric 40-140 g/m2 (production 96 to/day in each plant). It is thought the material is for wrapping steel pipes and the plants replace existing dry-laid ones.

1 plant in USA. 4.2 m wide at a cost of £ 8 m for tea bags and disposable medical fabrics.

Stora Kopparberg have extended their machine to give a production of 650 kg/hr. Beside the usual wet-laid products Tampella make fabrics up to 300 g/m2 for use as substrates in artificial leather. Another firm is using mineral fibre to make a special floorcovering for athletics.

Many wet-laid fabrics are compacted or crêped after production. An alternative is to use a percentage of heat-shrink fibres which will give the same crêping effect on the machine, without a finishing process.

9. Spun-bond fabric

There are at present 27 factories in the world with spun-bond lines, but some may have more than one. The EEC production is 48 mill.kg (24% of total non-wovens) and the Japanese total is 10.5 mill.kg, though they could produce 30 mill.kg on full production. Products range in weight from 17 g/m2 to about 125 g/m2 (though the needled types are heavier). Uses include coverstock, interlinings, coating substrates, backing for tufted carpets and civil engineering. Typical selling prices for carpet backing are:

Lutravil 24 p/m2
Loctuft 22 p/m2
Typar 18 p/m2
Light wieght Typar 12-14 p/m2.

It is reported that Corovin polypropylene will soon be used in work clothing.

The demand for the DuPont spun laced fabrics is increasing rapidly, but mainly for wall coverings i.e. non-textile uses.

Clearly over the last ten years spun bond fabrics have expanded very rapidly, but nevertheless dry laid fabrics have continued to expand in the face of this competition and it is thought that this will continue.

10. Needled fabrics

The Rontex system of winding card web spirally into a cylinder and needling it which has been used for some time has been extended to make very small tubes (4 mm circumference) for artificial veins and very large tubes (50 m circumference) suitable for papermakers felts.

There has recently been a lot of interest in needling ceramic fibres to make felts for high temperature insulation with about 3 lines in UK alone. A new fabric using needled Nomex has been designed for carrying the fabric through transfer printing.

The percentage of needled blankets increased from 66% in the UK in 1977 to 75% in 1978. Industrial felts, filtration felts and paper-felts are continuing to do well in the UK, but needled carpets are still much smaller than in France and Germany.

11. Stitch bonding

There are 2,500 machines in the world, of which just over 100 Mali type and probably 30 - 40 Arachne are in the UK. The numbers in the rest of the EEC are relatively small. Companies in America bought a lot of machines at an early stage, but have never achieved any great commercial success. There are now 6 companies in the USA with machines and it is reported that they are making a substrate for vinyl leather for car roofs. It is not clear if these are glued onto the metal or used as flexible roofs. Many American machines have been sold to UK companies.

The two main UK companies concentrate on making white fabric of fairly constant type. Most of this is printed by other firms for curtain fabric, some is piece dyed for slipper linings, some is dyed and raised for children's dressing gowns and a small amount is being used for upholstery in caravans. Courtaulds have 15 Arachne, 15 Maliwatt and produce 15 mill. m2/year using 80% viscose/20% nylon or 90%/10% blends.

The only new product that I am aware of is a structure made from polyurethane foam with fibre lightly needled into it and then stitch-bonded with tricot stitch in large stitches. The product is used in car doors as sound insulation. Other uses have been tried, but the structure was found to be too weak.

The Malifol machine using oriented polyolefene sheets has not been used in UK yet. Normal weaving with gripper shuttles or rapier is preferred for carpet backing and sacks.

The UK stitch bond machine Locstitch has not been very successful, but is installed in 10 factories, all abroad.

The patent case between Mali and a UK firm about the use of a particular cam timing to include some batt fibres into the knitted stitch of a Maliwatt construction has been completed. The UK firm's patent was upheld and Mali are not allowed to recommend this anti-run construction to their customers.

12. Instrumentation

The Duesberg-Bosson Servolap method is the best known one for automatically controlling the input to a carding line. It is claimed to give a maximum variation of $\mp 2\%$ and a maximum production of 1,000 kg/hr. So far as I know very few of these units are being used in non-wovens. A UK firm is beginning to make a similar unit but none have been sold yet.

Probably the most advanced form of control is being used on a wet-lay machine. The weight/m2 is measured at the output by means of a B-ray gauge. The information is then fed into a digital computer and the computer controls the machine.

Three firms are making a more advanced method of controlling output of sheet making machines (nonwovens, paper, film, etc.) which can measure the whole area of the sheet unlike the B-ray gauge. The principle is that a laser beam is made to scan across the fabric by a rotating mirror. Either by collecting the reflected light or the transmitted light the average weight /m2 can be measured, in fact it can detect even very small holes (e.g. 4 mm2) running at high speed (200 m/min). Although some machines are in use, I do not think there are any in nonwovens.

CHAPTER 5

Brief remarks about the experimental medical fabrics made at Lőrinci T.V., 7th March 1979

Seven (7) experimental fabrics were made to replace an imported non-woven. Of these four were made much heavier in weight, presumably for some other purpose.

T/1083 shows bad creasing, but is otherwise suitable e.g. for footwear;

T/1084/a and /b are both unsuitable due to delamination;

T/1085 seems to me to be suitable for the intended purpose;

T/1086 is suitable, but not so good as T/1085 due to the coarser fibres;

T/1087 shows needle holes and has a lot of loose fibre on one surface;

T/1088 would be suitable for heavier weight fabrics, but shows bad creasing.

Recommendation

T/1085 seems suitable for the intended purpose.

Some other fabrics could also be made commercially acceptable with a little further development.

CHAPTER 6

Possible new uses for stitch bonding machines

1. Malimo

   i) Support fabric for conveyor belts,driving belts, V belts, etc. (tyre cords?);

   ii) Support fabric for PVC coating
   - lorry covers, boat covers
   - awnings and inflatable buildings
   - table cloths, roller blinds;

   iii) Vegetable sacks from PP film yarns (also made on weft in-lay warp knitting machines);

   iv) Decorative open-work curtains with a deliberate irregularity.

I think the general policy should be to avoid making any fabric which could equally well be woven e.g. curtain fabric, clothing fabric and towel fabric because weaving is cheaper in the final fabric and the appearance is more even.

2. Maliwatt

My general impression is that the coarse gauge machines are limited in production possibilities to waddings, cleaning cloths, etc.

Other possible uses for these machines are as substitutes where needled fabrics are used now, e.g.

i) filter fabrics (needle holes may prove to be a weakness);

ii) green house watering fabric (PES or PP with the same stitching threads, because it is important that the fabric should not rot);

iii) sound and heat insulation (here price will be most important).

In the fine gauge machines (18-22 F) my opinion is to copy the products which are already very successful in Britain.

i) Curtain fabric.

It is important to use long fibred viscose 6-7dtex 150 mm, to use continuous cross-laying and to use good sewing thread (90-120 dtex continuous filament PES). Machine efficiencies can be very high.

One problem is that the stitching threads can unravel in use. This problem has been largely solved by a British patent, in which a few fibres from the web are knitted into the stitch (effectively combines Maliwatt and Malivlies). I think the patent is still valid, but doubt if one was applied for in Hungary.

The second important point to remember is that however good the fabric is technically, it will only sell if the colour and design are good. Thus the printing is equally as important as the non-woven production. Printing is normally done by the pigment method, which helps to increase pill resistance. It seems to me that very good designs and colours should be bought from a specialist curtain designer before trying this product on a large scale.

ii) Children's outerwear.

This product is made from viscose rayon with a fire retardant finish for safety. One face is raised and lightly cut, to give an even pile length. The pile completely covers the stitching threads. The fabric is inclined to pill badly, but even woven fabrics of a similar appearance also pill. In any case the product continues to sell steadily in Britain.

iii) Soft-lining for slippers and/or possibly shoes.

This fabric is similar to the one above except that less pile is raised and the cutting is closer. There is a steady demand in Britain, but it is not large.

iv) Backing fabric for artificial leather.
Although this use is not present in Britain, it seems to me that Maliwatt fabric is suitable technically and economically for backing artificial leather. If the customer requires a stronger, more dimensionally staple fabric then Malimo could also be used.

3. Voltex

Although the Voltex machines are fully used at the present time I think it is important to remain one step ahead by having an alternative product already developed in case the existing market fails. In Britain for instance sliver knitting (Wildman machines) is preferred to Voltex and the importation of several of these machines could alter the situation drastically.

One possible product is a blanket made by raising the loop side of the Voltex structure. Obviously stock dyed fibre or printing can be used for colouring. One prime consideration is to find a base fabric which is strong enough but at the same time cheap. Faulty fabric is an obvious possibility.

Apart from this idea it only seems to be possible to vary the height and weight of the pile to make it suitable for different end-uses.

4. Malivlies

This fabric seems most similar in production and properties to needled fabric, so it seems to me that other end-uses should be found as substitutes for needled fabrics. Possible ideas are:

i) Filtration fabrics;
ii) Blankets, after raising on one or both sides. The fabric may lack sufficient dimensional stability but it may be possible to include warp threads as in the case of needled blankets;

iii) Children's outerwear after raising. Again fabric may lack stability and will also tend to pill, but it may be good enough for a child's winter coat, for example, which will not be expected to last as long as an adults.

iv) Shoe and garment lining, etc.

5. Malipol

These machines pose the greatest problem because they have basically only one product, a one-sided loop pile structure.

If this product is raised it forms a good imitation fur or lining fabric, but it tends to be more expensive than Voltex due to the cost of spinning the yarn. A further drawback is the amount of pile yarn wasted on the back of the fabric. However if the fabric is raised on the knitted side rather than the pile side there is a very significant saving in yarn. If this has not been tried previously it may be worthwhile experimenting.

One advantage of the Malipol structure is that it is possible to make a stable structure with a lighter weight than Terry weaving or loop pile knitting. Such fabrics when printed can be used for beachwear, leisure wear and bathroom or kitchen curtains. As mentioned above colour and design are extremely important.

Other ideas are:

i) Make a fairly heavy weight fabric, print and sell as a bath mat;

ii) Coat the loop side with adhesive/abrasive mixture and sell as a pan cleaner.

In all cases suitable second grade backing fabric can be used to cut costs.

However, I think that if these ideas do not work the older machines should be scrapped slowly and the economics of converting the newest ones to Voltex should be calculated.

CHAPTER 7

Opinion of the operation of Lőrinci Textipari Vállálat

1. General

It should be stressed that all comparisons which are made are with West European firms, not with other Hungarian firms, because the author has no experience of the latter. Although personalities are obviously involved the greatest care will be taken to make this opinion as objective as possible.

2. Use of labour

a) in direct production

The general impression is that rather more workers are used than for a similar amount of work in W. Europe, possible about 20% more. Several reasons can be given for this:

- greater use of labour saving devices;
- machine modifications to make work easier;
- apparently greater skill and dexterity.

b) in organisation and management

Here there is a very strong impression that far more people are involved in indirect labour, organisation and management than in a similar sized West European firm. The difference is estimated at about 40 - 50%. For example an English firm with 16 Arachne lines making 13 mill.m2/year employs only 5 management people. Possible reasons are:

- in West Europe one person will have several responsibilities, whereas in Lőrinci T.V. each person has just one responsibility;
- it has possibly been traditional to have a large organisation structure;
- more paperwork and organisation may be required than in Western Europe.

It is felt that the result of these two differences makes the labour cost of the product about the same in Hungary and Western Europe, in spite of the difference in wage levels.

3. The use of production facilities

The different machines used in the factory each have different problems, so they have to be dealt with separately.

i) Chemical bonding line

The products of this machine sell very well and it is always fully used. It is in production for 80 - 85% of the time compared with an estimated 90-95% in Western Europe. Probable reasons for the difference are

- more frequent changes of cloth type;
- longer time spent in cleaning.

The factory is intending to introduce a four-shift system in order to increase the total running time of this machine.

ii) Maliwatt machines

It is an interesting fact that although exactly similar machines are used in Western Europe, the products are entirely different. In Hungary the products are mainly made on coarse gauge machines and are

- wadding for clothing;
- machinery cleaning cloths;
- household cleaning cloths;
- semi-disposable baby napkins.

All these products have been available for some years and there is a noticeable tendency for orders to decrease. The machine efficiencies are quite low (60% compared with about 80% in Western Europe), probably mainly due to the lower quality of sewing thread used. Labour is scarce in the factory and is diverted from these machines, but if they were fully staffed and run at higher efficiency it would probably be impossible to sell all the production.

In Western Europe fine gauge machines are used to produce two main products:

- material for printed curtains;
- children's outerwear and slipper linings.

Unfortunately the factory has only one or two fine gauge machines which could be used in this way. If demand continues to decline there is urgent need for the development of new products for the coarse gauge machine, but this will not be easy.

iii) Malimo machines

Again the products of these machines are quite different in Western Europe and Hungary. In Lőrinci T.V. the only product is a flat towel for Government Contract, which could equally well be made by weaving. In Western Europe it has been recognised that the Malimo cannot compete with a loom economically and that therefore Malimo machines must be used for fabric which cannot be made by weaving. The main examples are

- fabrics with very low extensibilities for industrial uses, e.g. coating substrates for tarpaulins, conveyor belts, driving belts, etc.,
- decorative curtains with about 1 thread/cm and an uneven weft distribution.

  It is suggested that it would be sensible to investigate these fields to supplement or possible replace the Government Contract.

iv) Malivlies machine

There are few if any of these machines in Western Europe, so no comparison is possible. The main problem seems to be that any increase in production from this machine reduces the demand for wadding from the Maliwatt machines, which is already a serious problem.

v) Malipol machines

Again there are very few of these machines in Western Europe so direct comparison is impossible. There is a very severe shortage of orders, so that all the machines are stopped at the present time.

The main reasons for this are:

- Malipol fabric is not competitive with woven Terry fabric or with loop pile Jersey fabric;
- The imitation fur previously made on the Malipol machines can now be made more economically by Voltex.

The only possible solutions seems to be to develop a light weight Malipol fabric which cannot be produced in a stable form by the other systems. This could then be printed for making leisure wear clothes or curtaining. There is however a shortage of suitable ground fabric, according to information given by the factory.

Other possible uses are as a base for a pan scrubber and for printed bath mats, but neither of these is a big market unless exports are also made.

The conversion of one machine to Voltex, for which a good demand exists, seems to be a good idea.

vi) Voltex machines

The two machines concerned run efficiently and there is no problem at all in selling the product.

vii) Quilting machines

Again the products from these machines sell readily and there are very few problems. Occasionally production is held up due to lack of brocade fabric.

4. Use of materials

i) Re-use of waste made in the factory

Most of the waste made in the factory is re-used. If it is in good condition it is fed back into the same quality, but if it has deteriorated during processing it is fed back into the next quality lower. This is standard textile practice throughout the world.

For a number of reasons some wastes cannot be re-used and these are considered below.

- Edge waste after chemical bonding - estimated 10 to /year (about 5% of total production);
  These fibres cannot be re-used because they are tightly bonded together. So far as I know none has found any use for this waste.

- Cutting waste from Voltex - estimated 5-8 to/year (about 3% of total production)
  These fibres cannot be re-used because they are too short. Again this is standard practice in textiles;

- Narrow strips of Maliwatt fabric left after cutting into cleaning cloths estimated 15-20 to/year (about 2½ - 3% of total production)
  These fibres are very short because the strips are narrow and the original fibre was only low quality waste.

- Waste made during raising the Maliwatt wadding estimated 15 - 20 to/year (about 2% of total production)
  It is not usual to use raising waste for reprocessing due to the shortness of the fibres. In this case the material is particular poor because it was originally waste. Hence although the total wastage is estimated at between 45 and 58 tonnes, it forms quite a small percentage of the total production and is virtually without any value.

ii) <u>Buying of raw material</u>

It is generally known that there is at present an overproduction of many synthetic fibres in Europe. This has led to a two-tier price system, a higher price for branded fibre bought directly from the fibre producer and a lower price for unbranded fibre bought indirectly. The unbranded fibre obviously carries no guarantee but many nonwoven manufacturers use it in non-critical uses with a large saving in raw material costs. Apparently Hungarotex have never offered Lőrinci T.V. such fibre. In view of the possible savings involved this seems worth investigating.

A somewhat similar situation arises in the case of the ground cloth for Voltex and Malipol. A West European manufacturer takes the view that since the fabric surface is completely hidden by the pile applied, a fabric of inferior appearance is satisfactory, provided that it is not of lower strength. He is therefore able to buy a cheaper, second-quality ground fabric. Apparently in Hungary it is difficult to find sufficient ground fabric; it seems to be worthwhile investigating the possiblity of importing suitable cheap cloths from India, HongKong, Turkey, etc.

5. Other important points

i) Selling abroad

It is disturbing that Lőrinci T.V. have only one contract to sell directly to the West, though other products are exported indirectly in clothing. It seems to me that this is partly due to a lack of understanding of what the Western markets want. I can understand that Hungarotex is solely responsible for all experts, but would suggest that an arrangement for a member of the firm to accompany the Hungarotex person abroad would be a good idea.

ii) Product development

In many textile firms the products are fairly standard but in nonwoven firms the possible products and the possible uses for the products are expanding continuously. Consequently it is very important for a nonwoven firm to have a very lively and energetic product development department. I am of the opinion that Lőrinci T.V. is very lacking in this respect.

iii) Collaboration between sections

Lőrinci T.V. has an energetic market research section, with many new ideas. I formed the opinion that other sections of the company were not giving this section the backing it deserved. Perhaps an improvement could be achieved by a reorganisation placing Market Research and Product Development under the leadership of one person.

CHAPTER 8

Summary of discussion on Wool Problems at the Textile Research Institute, Budapest

It should be stressed that the opinions expressed here are based only on data and opinions given during the discussion. The writer did not have sufficient time to get any direct experience of Hungarian wool, or to see how it is sorted, scoured or how is is processed in the factories and into what types of cloth. The opinions expressed can therefore only be tentative.

If in the future it is thought to be desirable, I would be willing to come to Hungary again to study the problems in detail and to help in their solution. In this case I think it would be a good plan to correspond with selected wool experts in Hungary prior to coming again and to have the opportunity to study typical samples of Hungarian wool in Leeds prior to my visit, with details of the cloth types usually made from them.

1. Wool quality

The problem of quality was discussed and it was stated that quality was slowly deteriorating because the cooperatives were tending to concentrate on meat. It is my opinion that we can only concentrate on the textile part of this problem, that is, is the wool being used to the best possible advantage? As noted above I am not in a position to answer this question.

2. Problems of classing and sorting

The general pattern in Australian wool production is to class the fleeces very carefully indeed with the result that hand sorting of the fleece is almost unnecessary. However it is difficult to say if such classing is possible in Hungary or if there are people experienced enough to do it. The fact that the fleece falls apart makes the normal method of sorting impossible but it may be possible to combine shearing and sorting into one operation.

3. Wool staining and vegetable contamination

Wool staining is a problem which I think can only be solved by altering the living conditions of the sheep, which is probably not possible. Some mechanical means of removing vegetable matter may be interesting and we have recently been studying two methods (cotton carding and crushing) at Leeds.

4. Methods of sampling the bales for testing

I am not aware of how the commercial transactions between the cooperatives, GY. T.V. and the factories are carried out, so it is difficult to comment on the sampling used. I may be able to help by suggesting a sampling grab which may sample from loosely packed bales. I will send this information direct to the Institute.

5. Possibility of carding wool on a cotton card

Quite a lot of work has been done on this topic at Leeds. The major advantage is that the wool can be cleaned more than in a worsted card, and this is obviously of interest for Hungarian wool. A lot of work remains to be done to find the optimum conditions for the card and to decide if it is a commercially viable idea.

6. Open-end spinning of wool

Again we have done a lot of work on this topic but so far it has only convinced us that wool is not really suitable for this system.

7. Processing wool on the cotton system

The short Hungarian wools should be quite suitable for spinning on the cotton system. In my opinion work should concentrate on a careful economic comparison of the two systems combined with a careful comparison of the yarn and fabric properties.

8. Processing wool/cotton blends

Hungarian wool should be very suitable for blending with cotton, but the important research is to find the most suitable grades of cotton for blending. It would only be possible to make a recommendation if all the grades of cotton available in Hungary were known.

9. Re-use of combing noil

Unfortunately I did not see any of this material, but it was described as "very contaminated with vegetable matter". I was told that normal carbonising techniques were not satisfactory. With this slight information I can only suggest either a closer study of carbonising to improve the performance or mechanical methods of removal.

10. Contamination of wool by Tar

Brands of marking fluid are available in both UK and Australia which scour out completely in normal scouring. I will send details of these direct to the Research Institute.

CHAPTER 9

Recommendations concerning a scholarship abroad

1. Introduction

The non-woven industry is moving very rapidly in Western Europe, which makes it particularly difficult for a person working in the non-woven industry in Hungary to keep completely up to date with the latest developments. This is extremely important however if the Hungarian nonwoven industry is to produce a modern range of goods at a competitive price and particularly important if the industry intends to export to Western Europe.

2. Recommendation

I would like to strongly recommend that a suitable person from Hungary should travel to Western Europe and study the non-woven industry, particularly in the following areas:

i) Factory organization
including the organization of the management structure and also the organization of the direct labour;

ii) Product development
if possible studying a number of examples from the early stages through to the final product by means of company records;

iii) Market research
particularly the research done before a new product is put on the market and also the relationship between the product development and market research departments.
It is clear from this outline that the scholar should work in factories rather than in Research Institutes or Universitites.

However, the non-woven industry has a tradition of secrecy and it may not be easy to find firms willing to give some training to a foreign competitor. It is suggested that the prestige of a direct request from

UNIDO may enable this problem to be solved. I have therefore given a list of firms in the UK who could be approached (Appendix 4). Depending on the total time available (3-6 months) and the size of the factory an itinerary should be planned. Suggested times are 2 - 3 weeks in a small factory, 4 - 6 weeks in a large factory. The order of priority is:

- chemical bonding - essential
- stitch bonding - quite important
- needling - only low importance.

If UNIDO would like further help e.g. a further list of addresses, I would be very happy to help, but I would prefer that the requests do not mention my name.

If it does prove impossible to organize the scholarship in this way then I can offer the facilities of the Department of Textile Industries, University of Leeds, where we have a section specialising in non-wovens and also one specialising in factory organization. In the past it has always been possible to arrange three or four one-day visits to non-woven firms; in this case an attempt would be made to arrange extended visits.

APPENDIX 1

WORK PROGRAMME

1. To consider in detail the three proposals received for building a plant to produce non-wovens in the range of 15-60 g/m2 bearing in mind the local conditions and to make recommendations.

2. To consider in detail the choice of machines for producing non-wovens in the range 70-200 g/m2 on the basis of three proposals, bearing in mind again the local conditions and to make recommendations.

3. To consider in detail the design of an experimental material line for producing a wide range of non-woven fabrics 1 m wide, the plant to be suitable to be run for production or development as desired and to make recommendations.

4. To present a survey of modern developments of non-wovens in Western Europe and to give a forecast of future developments.

5. To assist in any experimental work undertaken at Lőrinci Textilipari Vállalat, Budapest during the period.

6. To submit proposals for new products to be made on the Maliwatt and Malipol machines to enable them to work more efficiently.

7. To consider and make proposals regarding Hungarian wool production.

8. To submit a final report to the Hungarian Ministry of Light Industries and to UNIDO.

APPENDIX 2

EXPLANATORY NOTES ABOUT THE COSTING CALCULATIONS

1. The capital cost of the machine is normally the quoted price, but in some cases the price has been modified where some improvement to the line could be made. A standard 4% increase has been allowed to cover spare parts ordered at the same time. The rates of exchange used were:

US Dollar	=	37.4875	Ft.
Os Sch.	=	2.559	Ft.
F Fr.	=	8.4813	Ft.
Sw Fr.	=	19.0741	Ft.
D Mark	=	18.3483	Ft.
£ Sterling	=	72.73	Ft.
1,000 Lira	=	45.27	Ft.

2. The yearly cost of the machine is calculated from the eight equal yearly repayments that would be needed to pay the total cost plus interest at 8%. The factor is 0.17401. Other factors can be calculated from the formula $F = \frac{R\,(1+R)^n}{(1+R)^n - 1}$ where R is the rate of interest expressed as a decimal and n is the number of yearly repayments.

3. Electrical costs have had to be estimated in most cases. A standard charge of 1.11 Ft/Kw hr. has been used. In some cases the total loading exceeds the 250 kw loading still available on the existing cable and a new cable would be required. This cost has not been included.

4. Steam costs are based on quoted figures where possible, but otherwise are estimated. It has been assumed that the steam gives out 500 kcal/kg. A cost of 224 Ft/to plus 930,000 Ft/to/year has been assumed. The single charge of 3000,000 each additional tonne of demand has not been included.

5. Direct labour cost are based on total wages and taxes paid to 22 workers in one year, 925,000 Ft.

6. The item "overheads" includes the total wages and taxes paid to all the administrative and indirect labour (18,572,000 Ft), 1,877,000 Ft for transport and 6,412,000 Ft for heating. The overheads have been divided proportionally to the number of direct workers employed. The value and upkeep of buildings, the cost of a humidification system, the cost of additional transport inside the factory, the yearly machinery tax and the cost of a new compressor (except where this is in the offer) have not been included.

7. The cost of water is very minor, but has been taken as the average of water use quoted and actual water use on the existing line.

8. Raw material prices

The following fibre prices have been used. Present UK prices are given for interest

Viscose	43.98 Ft/kg	(UK 44.36 Ft/kg)
Polyester	90.47 Ft/kg	(UK 36-61 Ft/kg)
Polypropylene	67.00 Ft/kg	(UK 63-69 Ft/kg)

Binder prices are based on:

	Basic price		Dry weight cost
Plextol DV 580	53.75 Ft/kg	60% solids	89.58 Ft/kg
Plextol DV 300	53.93 Ft/kg	60% solids	89.88 Ft/kg
Grilat	35.10 Ft/kg	40% solids	87.75 Ft/kg
	Average		89.07 Ft/kg

The fabric has been assumed to contain 25% binder, 75% fibre. An allowance for waste has been made, 5% for edge cutting plus 10% for starting up, breakages, etc., giving a total of 15%.

9. <u>World price of coverstock for comparison</u>

Prices of coverstock do vary slightly according to method of manufacture, fibre content etc., but the variations are so slight that they can be ignored for this comparison. The following table gives the selling price of 15 g/m2 coverstock per m2.

Source and date		Selling price	Import from Finland 10% duty	Price in Hungary after 42% customs duty
Austria	1973	2.36 Ft/m2	2.60	3.35 Ft/m2
France	1977	2.01 Ft/m2	2.21	2.85 Ft/m2
USA	1978	1.89 Ft/m2	2.08	2.68 Ft/m2
UK	1978	2.18 Ft/m2	2.40	3.10 Ft/m2
Sweden	1979	1.83 Ft/m2	2.01	2.60 Ft/m2
Average		2.05 Ft/m2	2.26	2.92 Ft/m2

Since the prices are roughly constant in spite of inflation it is suggested that the average prices should be used for comparison. The price does not vary significantly with fibre content because it is possible to buy polyester at almost the same price as viscose. The import duty varies depending on the country of origin and the category into which coverstock would be classified, but the values of 10% and 42% give lower and upper limits.

Other competing materials are:

Smith & Nephew expanded P.E. film	9 g/m2	1.96 Ft/m2
	9.5 g/m2	2.18 Ft/m2
French expanded P.E. film	7 g/m2	1.42 Ft/m2
	11 g/m2	2.11 Ft/m2
	7 g/m2 film + 7 g/m2 fibre	2.04 Ft/m2.

APPENDIX 3

DETAILED COSTINGS FOR SEVEN LINES

1. Babcock-Hergeth Line

Capital cost of plant with reduced mixing capacity and including an estimate for spare parts	58,275,000 Ft
Custom duty at 23.5%	13,695,000 Ft
Installation costs	2,000,000 Ft
	73,970,000 Ft
Tax at 3.9%	2,885,000 Ft
Total cost of machine	76,855,000 Ft

	Yearly cost
Cost of machine yearly, assuming depreciation over 8 years with 8% interest rate	13,374,000 Ft
Electrical costs 60 kW heating + 106.4 kW power = 166.4 kW x 5,000 hr	925,000 Ft
Steam costs 576,000 kcal/hr = 1.15 to/hr x 5,000 hr	1,288,000 Ft
+ yearly charge	1,070,000 Ft
Direct labour 5 people x 3 shifts = 15	631,000 Ft
Overheads (administration, buildings, transports, etc.)	1,236,000 Ft
Yearly total cost of spares at 4% total cost .	2,879,000 Ft
Water cost say 10 to/day = 3,000 to	168,000 Ft
Total yearly cost	21,571,000 Ft

Estimated yearly production of 15 g/m2 coverstock = 30 mill.m2 (5,000 hrs). Total production costs = 0.719 Ft/m2

Total cost price	100% Viscose + binder =	1.672 Ft/m2
	100% PES + binder =	2.273 Ft/m2
	100% PP + binder =	1.970 Ft/m2
	50%V/50%PP + binder =	1.821 Ft/m2

2. <u>Tessiltechnica 73,281</u>

Capital cost of plant including estimate for spare parts	25,575,000 Ft
Customs duty at 23.5%	6,010,000 Ft
Installation costs	2,000,000 Ft
	33,585,000 Ft
Tax at 3.9%	1,310,000 Ft
Total cost of machine	34,895,000 Ft

	Yearly cost
Cost of machine yearly, assuming depreciation over 8 years with 8% interest rate	6,072,000 Ft
Electrical costs (estimate) 100 Kw x 5,000 hr ...	555,000 Ft
Steam costs (estimate) 425,000 kcal/hr = 0.85 to/hr	952,000 Ft
x 5,000 hr - yearly charge	791,000 Ft
Direct labour 5 people x 3 shifts = 15	631,000 Ft
Overheads (administration, buildings, transport,etc.)	1,236,000 Ft
Yearly cost of spares at 4% of total cost	1,263,000 Ft
Water cost, say 10 to/day = 3,000 to	168,000 Ft
Total yearly cost	11,668,000 Ft

Estimated yearly production of 15g/m2 coverstock = 35.4 mill.m2 (5,000 hrs)

Total production costs = 0.330 Ft/m2

<u>Total cost price</u>	100% Viscose + binder	1.283 Ft/m2
	100% PES + binder	1.884 Ft/m2
	100% PP + binder	1.581 Ft/m2
	50%V/50%PP + binder	1.432 Ft/m2

3. Tessiltechnica (using reduced plant, i.e. one line only)

Capital cost of plant including estimate for spare parts	14,547,000 Ft
Customs duty at 23.5%	3,419,000 Ft
Installation costs	2,000,000 Ft
	19,966,000 Ft
Tax at 3.9%	779,000 Ft
Total cost of machine	20,745,000 Ft
	Yearly cost
Cost of machine yearly assuming depreciation over 8 years at 8% interest rate	3,610,000 Ft
Electrical costs (estimate) 55 kW x 5,000 hrs	305,000 Ft
Steam costs (estimate) 0.425 to/hr	476,000 Ft
Yearly charge	395,000 Ft
Direct labour 3 people x 3 shifts = 9	379,000 Ft
Overheads (estimate)	800,000 Ft
Yearly cost of spares at 4% of total cost ..	719,000 Ft
Water cost, say 5 to/day = 1,500 to	84,000 Ft
Total yearly cost	6,768,000 Ft

Estimated yearly production of 15 g/m2 coverstock = 17.7 mill.m2 (5,000 hrs).

Total production cost = 0.382 Ft/m2

Total cost price	100% Viscose + binder	1.335 Ft/m2
	100% Polyester + binder	1.936 Ft/m2
	100% Polypropylene+binder	1.633 Ft/m2
	50% Viscose/50% PP+binder	1.484 Ft/m2

4. Brückner, Spinnbau, Temafa

Capital cost of plant including a waste hopper but excluding the oiling system, including an estimate for spare parts	77,067,000 Ft
Customs duty at 23.5%	18,111,000 Ft
Installation costs	2,000,000 Ft
	97,178,000 Ft
Tax at 3.9%	3,790,000 Ft
Total cost of machine	100,968,000 Ft

	Yearly cost Point bond (Ft)	Yearly cost Print bond (Ft)
Cost of machine yearly assuming depreciation over 8 years at 8% interest rate	17,569,000	17,569,000
Electrical costs power 160kW	888,000	888,000
Heating 116 kW	644,000	-
Steam costs (estimate) 0.64 to/hr	-	718,000
plus yearly cost	-	595,000
Direct labour 5 people x 3 shifts	631,000	631,000
Overheads (administration, buildings, transport)	1,236,000	1,236,000
Yearly cost of spares at 4% of total cost	3,807,000	3,807,000
Water cost say 10 to/day=3,000 to	168,000	168,000
Total yearly cost	24,943,000	25,612,000

Estimated yearly production of 15 g/m2 coverstock = 26.4 mill.m2

Total production cost	0.945 Ft/m2	0.970 Ft/m2

Cost price (point bond)	
50%V/50% PES	2.105 Ft/m2
50%V/50% PP	1.903 Ft/m2
100% PES	2.506 Ft/m2
100% PP	2.101 Ft/m2

Cost price (print bond)	
100% Viscose + binder	1.923 Ft/m2
100% PES + binder	2.524 Ft/m2
100% PP + binder	2.221 Ft/m2
50%V/50%PP + binder	2.072 Ft/m2

5. Kleinewerfers (point bond)

	2 m wide (Ft)	2.5 m wide (Ft)
Capital cost of plant including a waste hopper and estimate for spare for two years	45,477,000	51,756,000
Customs duty at 23.5%	10,687,000	12,163,000
Installation costs	2,000,000	2,000,000
	58,164,000	65,919,000
Tax at 3.9%	2,268,000	2,571,000
	60,432,000	68,490,000

	Yearly cost	
Cost of machine yearly assuming depreciation over 8 years at 8% interest	10,515,000	11,918,000
Electrical costs power 160 kW (200 kW)	888,000	1,110,000
(estimate) heating 110 kW (130 kW)	610,000	721,000
Directo labour 5 people x 3 shifts	631,000	631,000
Overheads	1,236,000	1,236,000
Yearly cost of spares at 4% of total cost .	2,247,000	2,557,000
Water cost (estimate)	168,000	168,000
Total yearly cost	16,295,000	18,341,000
Estimated yearly production (15 g/m2)	16.2 mill/m2	20.7 mill/m2
Total production cost	1.006 Ft/m2	886 Ft/m2

Total cost price

50%V/50% PES	2166 Ft/m2	2046 Ft/m2
50%V/50% PP	1964 Ft/m2	1844 Ft/m2
100% PES	2567 Ft/m2	2447 Ft/m2
100% PP	2162 Ft/m2	2042 Ft/m2

6. Kleinewerfers (print bond)

Machinery costs exactly as for point bond.

	Yearly cost	
	2 m wide (Ft)	2.5 m wide (Ft)
Cost of machine yearly depreciated at 8% interest over 8 years	10,515,000	11,918,000
Electrical cost 200 kW (250 kW) (estimate)	1,110,000	1,388,000
Steam costs 0.92 to/hr (1.15 to/hr) (estimate)	1,030,000	1,288,000
Yearly charge	856,000	1,070,000
Direct labour	631,000	631,000
Overheads	1,236,000	1,236,000
Yearly cost of spares at 4%	2,247,000	2,557,000
Water cost estimate	168,000	168,000
Total yearly cost	17,793,000	20,256,000

Estimated yearly production (15 g/m2)	16.2 mill/m2	20.7 mill/m2
Total production cost	1,098 Ft/m2	0.979 Ft/m2

Total cost price

100% Viscose + binder	2051 Ft/m2	1932 Ft/m2
100% PES + binder	2652 Ft/m2	2533 Ft/m2
100% PP + binder	2349 Ft/m2	2230 Ft/m2
50%V/50% PP + binder	2200 Ft/m2	2081 Ft/m2

7. <u>Hirag</u>

	1m wide (Ft)	2.2m wide (Ft)
Capital cost of plant including an opening unit and an estimate for spare parts	24,210,000	31,532,000
Customs duty at 23.5%	5,689,000	7,410,000
Installation costs	2,000,000	2,000,000
	31,899,000	40,942,000
Tax at 3.9%	1,244,000	1,597,000
	33,143,000	42,539,000

Cost of machine yearly assuming depreciation over 8 years at 8% interest rate	5,767,000	7,402,000
Electrical costs 75 kW 100 kW x 2,500 hr	208,000	277,000
Steam costs (estimate) 0.45 0.85 to/hr x 2,500 hr	252,000	476,000
Yearly charge	418,000	790,000
Direct labour 5 people x 3 shifts .... (half-time)	315,000	315,000
Overheads	1,236,000	1,236,000
Yearly cost of spares	1,196,000	1,558,000
Water cost (half-time)	84,000	84,000
Total yearly cost	9,476,000	12,138,000

Estimated yearly production (15 g/m2)	5.7 mill/m2	13.2 mill/m
Total production cost	1,662 Ft/m2	920 Ft/m2

<u>Total cost price</u>

100% Viscose + binder	2615 Ft/m2	1873 Ft/m2
100% Polyester + binder	3216 Ft/m2	2474 Ft/m2
100% Polypropylene + binder	2913 Ft/m2	2171 Ft/m2
50%V/50% PP + binder	2764 Ft/m2	2022 Ft/m2

APPENDIX 4

POSSIBLE FIRMS TO TRAIN A PERSON FROM HUNGARY

1. Chemical bonding

Bonded Fibre Fabrics Ltd. Bath Road Bridgewater Somerset	Disposables, interlining etc.
Bondina-Vilene Ltd. Greetland Halifax	Mainly interlinings and durable wiping cloths
British Interlining Manufacturing Association 81, Wimpole Street London WIM 7 DB	An association, but may be able to arrange through its members
Vernon Carus and Sons Ltd. Hoddleston Mills Darwen Lancs.	Disposables
I.C.I. Fibers Ltd. Melded Fabrics Division Ho kstone Road Harrogate	Special heat bonded
Johnson and Johnson Ltd. Gargrave Nr. Skipton Yorks.	J. cloths and similar
Lantor Ltd. Rumworth Mill St. Helens Road Bolton BL3 3PR	Interlining etc.

2. Stitch bonding

Blackburn Cord Co. Ltd. Longshaw Mill Blackburn Lancs.	Curtain fabric
Dunlop Textiles Ltd. Castleton Rochdale Lancs.	Industrial fabric
Heron Fabrics Heron Mill Hollinwood Oldham	Curtain fabric

3. <u>Needling</u>

Edward W. Andrews Ltd. Premier Mills Walshaw Road Bury Lancashire	Filter fabrics
Bury and Masco Ltd. Hudcar Mills Hudcar Lane Bury	Carpets, filtration and needle felts for industry
Burmatex Ltd. Victoria Mills Ossett WF 5 OAN	Carpets
Bayrische Woll- Filzfabriken D-8875 Offingen/Donau Germany	Filter fabrics
John Cotton(Mirfield)Ltd. Mirfield Yorkshire	Low quality wastes for wadding
Don Bros., Buist and Co. Ltd. St. James Road Forfar DD8 2AL Scotland	Special products, particularly carpet backing
Dunlop-Semtex Ltd. Brynmawr Gwent Wales	Carpets and tennis ball covers

Charles Early and Marriot Witney Mills Witney	Blanket manufacturers
Fibragration Ltd. Gillroyd Mills Wide Lane Morley LS27 8PY	Development work in needling
Gaskell & Co. Ltd. Lee Mills Bacup OL13 ODJ	Needled carpets
E. Illingworth & Co. Ltd. Shelf Mills Halifax HX3 7PA	Carpets
Scapa - Porritt Ltd. Cartmell Road Blackburn	Paperfelts and filtration

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