UTILIZATION OF TEXTILE WASTES IN NONWOVEN FABRICS

By

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الاستفادة من العـــوادم النسيجية فى تصنيع أقمشـــة غير منسوجة.

الخلاصـــة :

تحتوى هذه المقالة على المعلومات الاساسية التى تصلح لمزيد من الدراسة حول الموضوعات التالية: (أ) التقسيم العام للعوادم النسيجية التى يمكن استخدامها فى صناعة الاقمشة الغــير منسوجة، (ب) المصطلحات المستخدمة للتعريف بالعوادم النسيجية، (جـ) تجهيز العـــــوادم النسيجية للتشغيل، [illegible] ت اللازمة لتحويل العوادم النسيجية الى شعيرات، (هـ) الاستفادة من العوادم النسيجية [illegible] الاقمشة الغير منسوجة ، (و) مسودة مشروع التحويل العـــوادم النسيجية الى أقمشة [illegible] بطريقة ميكانيكية، (ز) مشروع تأسيس مركز لتدريب الفنين والعاملين بقطاع الغزل والنسيج [illegible] كلية الهندسة بالمنصورة، (ى) الختام والتوصيات.

ABSTRACT

This article was carried out to provide [illegible] of information from which to make further studies on (a) classification of textile waste used in nonwovens; (b) textile waste terminology; (c) recovery and use of textile waste; (d) preparation of the waste for processing; (e) utilization of textile wastes in nonwoven fabrics; (f) project report on needle felted mats out of waste fibres for various end uses; (j) the project of training center; and (h) conclusions and recommendations concerning education and training center for nonwoven technology and pruducts.

Key-Words:

Soft wastes, Hard Wastes, Fabric waste, Mungo, Waste fro fabric raising, Shearings, Cutting and edges or slevedges, Noils, Sweeping, Knits, Finisning wastes, Waste Fibre processing, Typical scources of waste, Machines requirements, Tearing machine, Carding, Cross-Lapper, Needle looms, Intensity of needling, Finishing, Varaity of end-producta, Plant capacity, and Investment.

Aim of The Present Article:

The purpose of the present paper is to survey first the sources, quantities and types of textile wastes produced in the textile industry in A.R.E., Secondly to find the suitable technology for recycling these wastes and converting it to fibres and thirdly to select the suitable technology for producing nonwoven fabric according to the properties of the reaulted fibres.

1. INTRODUCTION

Dressing has been an old age desire of man. In rimeval ages as early as the Glacial period it was a more necessity, a protection against severe cold. Since theo until our time other factors have been gradually involved-fashion, function and last but not least-price.

Originally man used skins to dress when he discovered how to spin yarn of animal hair and natural cellulosic fibres was striving to produce a fabric of it that would give him the same protection against cold as animal skin. The first to be used was the matting technique and the first mat like fabrics might be well called predecessors of modern clothe. Thus in fact the origin of weaving may be explained as well.

Archaeological excavations have brought to light the weaving technique of the prehistoric period.

The historical beginninge of the modern textile manufacture can be placed in the 4th millennium B.C. It has teen proved that linen fabrics were woven in Egypt at the time. It has been also found that cotton fabrics were produced in India in 2000 B.C. It was from there that the art of cotton weaving spread over to the near esst and finally reached the antique Greece and Rome.

The modern weaving m/cs of the 2nd century have very little in common with the old land weaving looms. The power and automatic looms of the past centuries have been outdone by the latest shuttleless looms, jet looms and gripper looms in which new principles of weft insertion are used.

As a result of this the production of nonwoven textiles has been introduced which is the last development in the field of fabric production. It is a high production versatile system which involves considrable savings in labour and shortening of the production process and, above all, it makes the mechanization and automation of the textile production possible.

The main end uses are mentioned below (1):-

1- Fabrics for use in the ready-made (wadding) and shoe making (interlining) industries, fabrica for packing end uses, heat and sound insulating industrial fabrics,... etc.
2- Home furnishing fabrics such as decoration fabrics, carpet (interlayers), blankets, table cloths,... etc.
3- Outer wear fabrics for use in ladies and childrens coats, jakets and waste coats, ladies and childrens dresses, beach wear, leisure wear.
4- Fabrics for the manufacture of textile foot wear, linings for rubber foot wear, leather foot wear.

The textile manufacture in Egypt is one of the oldest and largest industries including both public and private plants. Total textile production is estimated to be 80% by the public sector and 20% by the private sector. The textile production represents 30% of the production of the whole industry in Egypt. The textile industry is responsible for about 50% of the industrial exports. Of the total man-power working in industry half is in the textile industry.

The recycling of fibre and waste textiles provides an important contribution to world textile output. It is of interest to consider the changes which have occurred over recent years in the total quantities of new raw materials processed on the basis of world consumption.

The last decade has been a move in the fibre-re-cycling industry from the U.K. to Italy, India, and South Korea, while the quality of many Italian products (woollens) produced from recycled fibre has made them very competitive problems of sorting and dyeing mixtures of recovered fibres have increased with the increasing use of synthetic fibres. Inspite of this the effect of the existing economic pressure forcing the textile companies to reprocess their own high fibre waste should not be ignored and many find the production of bonded fabrics the cheapest and most effective way out of this difficulty (2 and 3).

2. Classification of Textile Waste Used in Nonwovens (4):

One of the great sources of strength of any industry, including the textile industry, is the use of its by-products and the salvage of its waste materials for reuse as raw materials in its own or other fields.

Textile waste comes from four cources:

(1) The mills, which produce waste in the form of soft waste, threads, scraps, remnants, seconds, and pound pieces;
(2) The dye houses and finishing plants from which come improperly dyed pieces of cloth and materials damaged in processing;
(3) The apparel manufacturers, whose operations result in an accumulation of remnants and clippings; and
(4) The independent dealers and charitable organization who collect discarded clothing and other fabrics used in the home.

2.1. Definitions:

2.1.1. Soft Wastes (5):

Soft waste is a product of textile processes such as carding, combing, and drawing, and is classified as card waste, combing waste, roving waste, and laps. The main characteristics is that the material is still in a fibrous condition and therefore, in most instances these wastes are blended with virgin fibres before carding.

2.1.2. Hard Wastes (5):

The waste occurring after the spinning operations contains twist and is no longer in a fibrous form. For these reasons it is known as hard waste. This kind of waste occurs in spinning, twisting, respooling, winding, warping, and weaving.

2.1.3. Fabric Waste-Shoddy and Mungo (6):

When textile garments are discarded the fibres may still be strong, and by severe mechanical action the rags may be pulled apart into fibres that can be spun on the woolen system. New rags from "tailors" clippings are another source of remanufactured fibre. Old clothes are collected in many countries by the "litter" or rag-man, who also collects metal and other wastes from householders.

2.1.4. Mungo (7):

Mungo is the term formerly applied to fibres from old and new rags which have been fulled considerably, or are of a very firm structure (e.g. uniform kerseys, velours, and mettons). It consists of very short fibres, less than one half inch in length.

2.1.5. Waste From Fabric Raising:

Are obtained in the form of fibres combed-out by the surface of raising organs. Wastes from raising card-wire machines after drying are subjected to carding in cards (7).

2.1.6. Shearings:

Are short fibres 3-4 mm in length cut in the process of fabric shearing. Shearings are unspinnable, therefore they are collected, packed and sent to enterprises for use as a packing material (7).

2.1.7. Cuttings and Edges or Selvedges:

Are sorted into pure and soft wastes and processed into fibres on special pickers (7).

2.1.8. Noils (5):

These are the short fibres separated from the long wool in the combining process. They are equal in quality to virgin wool except for their length.

2.1.9. Sweepings (5):

The spinning and weaving room sweepings contain much usable material, such as short pieces of roving and yarn. After screening and sorting, a scouring and opening process follows, if necessary.

2.1.10. Knits (6):

Waste occuring in knitting operations, such as sweater clips. Such clips, owing to their low twisted yarns are easily opened and, therefore, can be classified as soft waste.

2.1.11. Finishing Wastes (6):

Cloth finishing produces three types of waste:
- flocks, from scouring and fulling,
- shear flocks and short ends, and
- sample wastes.

Flocks resulting from piece scouring, fulling, and raising are of a low grade because of their uneven length and their mixed and soild condition. Shear flocks are obtained from cropping or shearing piece goods, and constitute a valuable raw material for pressed felts, bedding packing and wall papers. Short ends and sample wastes, together with new tailor clippings, are the main source of reprocessed nonwoven fabrics.

2.2. Utilization of Textile Wastes in Nonwoven Fabrics:

Nonwoven textiles are manufactured from the same fibres as the conventional woven and knitted fabrics. The bonding technique, however allows even very short fibres to be used. Even fibres with an unfavourably shaped staple diagram, which could be processed only with great difficulty on traditional textile equipment for conversion to yarns and fabrics may be utilised, for example, many nonwoven articles (e.g. Tetex, Chemoral, Varal, Vatex, Netex) can be made from fibre stoks with staple diagrams of the shape in Figs. 1 and 2.

The staple diagram 1 is for fibre waste used for the manufacture of a heat-insulating woven cloth, whereas the staple diagram 2, with a much greater ratio of very short fibres, is indicative of fibre waste from which an adhesively bonded nonwoven textile for the same purpose can be made (8).

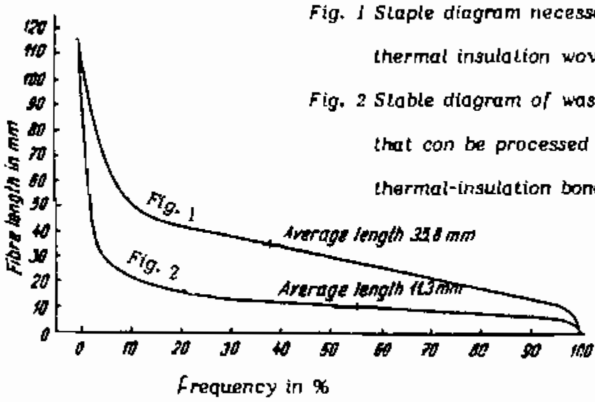


Fig. 1 Staple diagram necessary for a thermal insulation woven fabric

Fig. 2 Stable diagram of waste fibres that con be processed into thermal-insulation bonded texti-

The whole range of the nonwovens manufacture can be divided into several groups in which one of the main criteria is the type of the fibres used.

This division is as follows (9):-

(a) Nonwovens made by the paper-making techniques;
(b) Nonwovens for heat and sound insulation;
(c) Nonwovens for stiffening purposes;
(d) Nonwovens for industrial and technical uses (e.g. filters, bags, wrappings, etc.);
(e) Nonwovens for domestic purposes (dish cloth, dusters, napkins, bedsheets); and
(f) Nonwovens for outerwear apparel.

The Process Adopted For Making Nonwoven Fabrics (CGC):

From the viewpoint of fibre yield textile waste may be divided into three categories:

1- fibre waste, 2- thread waste, 3- fabric waste.

In the fabric instance it should be distinguished between industrial waste (i.e. trimmings and clippings from knitted and weaving mills and from the cutting rooms of the apparel industry) and rags (collected salvaged textiles).

It is evident that the waste containing filaments requires another method of opening than that containing short fibres or staple Fig. 3 shows different suggested methods for textile recovery of waste.

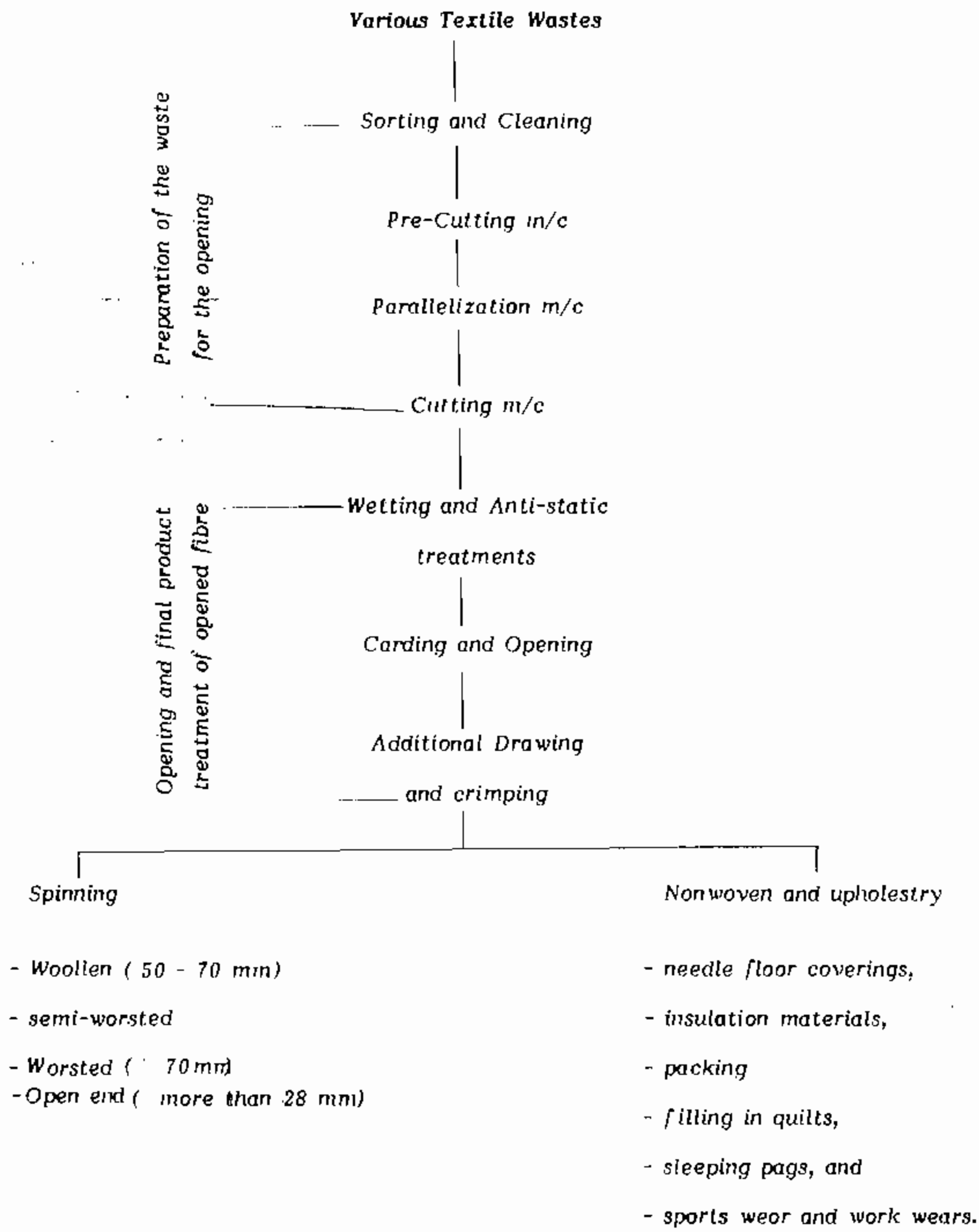


Fig. 3_a Shows Fibres Recovery from Soft and Hard Waste Out of Man-Made Fibres.

The recovery process of textile waste comprises principally three steps:

(a) Preparation of the waste for the opening,
(b) Opening of the wast into fibres, and
(c) Final treatments of the opened fibre waste.

Each step includes several operations which need not always be applied unless necessary or desirable technologically, or needed for the sake of quality.

1- Recycling of man-made fibre in shoddy form:

- Textile waste should first be cut down to 100 mm. lengths before presenting it to the rag tearing m/cs.
- Filament and thread wastes are parallelized on parallelized m/c.
- Following this is the cutting process. The cut length is adjustable from 0 to 150 mm.
- Depending on the type of waste, the opening can take place in either rag tearing m/cs and garnett m/cs.

Figure 3_a shows fibres recovery from soft and hard waste out of man-made fibres.

2- Recycling of Cotton Fibres in Soft/and Hard Waste Form:

The recycling of fibres from soft/and hard waste presents several possibilities. This requires the breakdown of finishing wastes into constituent fibrous materials by the cutting, garnetting, scouring and bleaching, drying, aerodynamic web formation, and then chemically reinforced. Having done this, and knowing the chemical nature of the mixture, several processes for nonwoven formation are available. Considering the quantity of waste cotton and viscose available this could make a major contribution of the reuse of cellulosic materials in sheet form. The scheme of cellulosic fibre recovery from both soft and hard wastes can be summarized as shown in Figure 3_b.

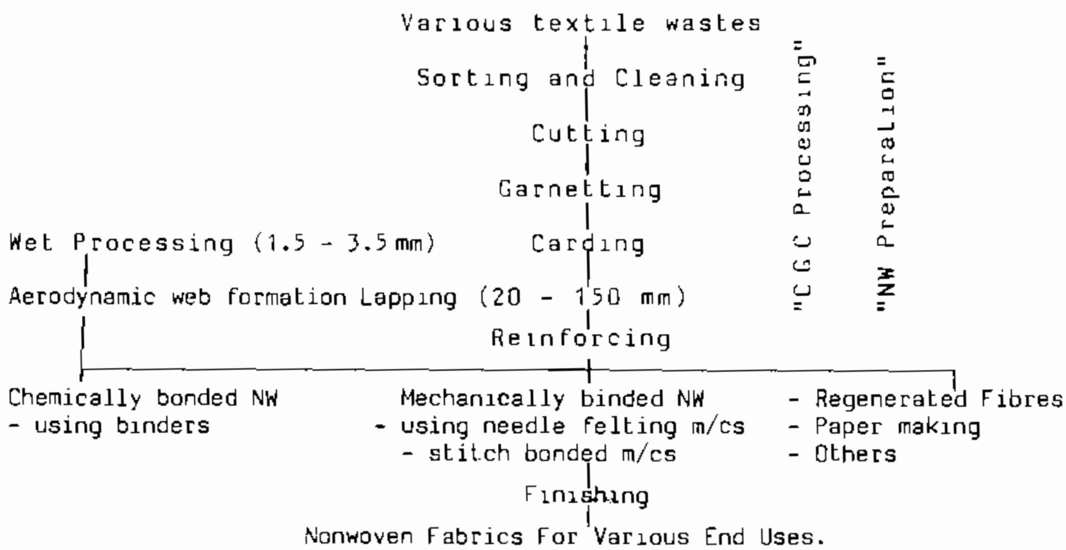


Fig. 3_b : Shows Fibres Recovery From Soft/end Hard Waste Out of Natural Fibres.

3- Recycling of Textile Fibres in Rags Form:

Dedusting of rags is an obligalory operation as it ensures normal sanitary and hygienic conditions for carrying out subsequent rag processing, reduces the content of impurities in the fibres obtained and consequently of the blend into which these fibres will be added.

Dust cleaning of rags is carried out in dusting machines of continuous and intermittent action.

Rags are sorted into fine, semi-fine, and coarse; wool and semi-wool; knitted, woven, milled and felt rags. Moreover, the rags are classified into new and old ones and according to their colour into white, black, multicolour, and others.

Scouring of rags is necessary if they are badly contaminated and they are not cleaned at dedusting. Scouring is a highly efficient operation as it ensure:

1- a more complete cleaning of rags;
2- less contamination of the machine working organs;
3- reduce breakage of fibres; and
4- washing-off dyes which do not strongly adhere to the rags, thus facilitating and improving cloth dyeing.

Opening and Picking of Rags:

The aim of this process is rag opening, dividing large rag into smaller ones and removal of dust with intensive cleaning from inpurities. Opening ensures favourable conditions for fibre blending and reduce the forces applied on the needles and fibres in carding owing to which the breakage of fibres is reduced and the life of fillets on the card working organs is increased.

Rag Picking and Garnetting:

After these pretreatments, the rags are oiled to facilitate the grinding or tearing up process. The oiled stock is allowed to stand for at least 12 hours to permit penetration of the oil. The oiled rag is then divided vertically to secure an even distribution of the sorted rags and placed on the lattic feed apron of the rag picker machine.

Fig. 3_c shows textile fibres recovery from mixed rages.

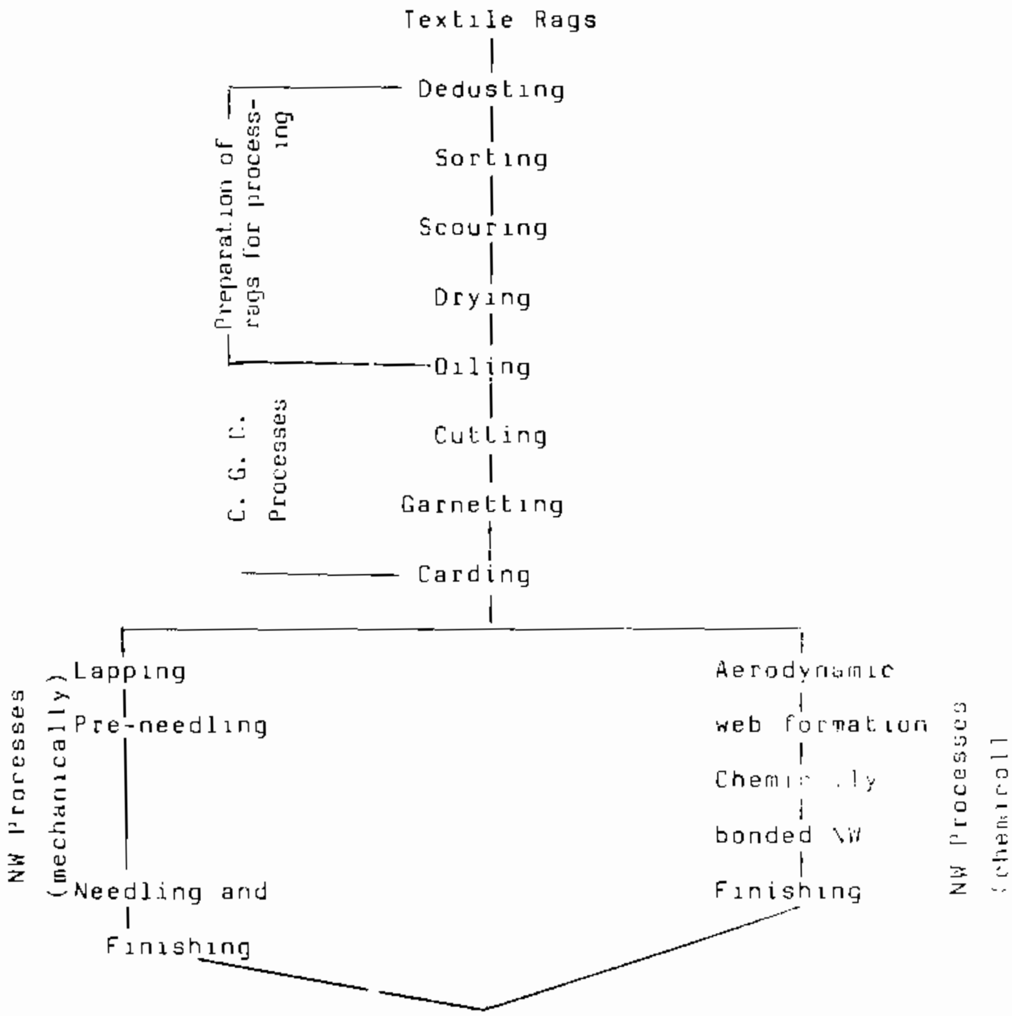
3. PROJECT REPORT ON NEEDLE FELTED MATS OUT OF WASTE FIBERS FOR VARIOUS END USES.

3.1. Making of needle felts (10)

Needle felting technology belongs to nonwoven process which does not involve any spinning, weaving or other canventional method of fabric production. In fact this is one of the simplest process to produce a fabric direct out of fibres.
Principal steps of manufacturing needle felted fabrics are following:

- fibre opening and blending
- carding (for heavy weight felts, an aerodynamic machine is also possible).

- cross lapping
- mechanical consolidation by means of needle felting
- finishing, depending on the end product requirements.



Nonwoven Fabrics For Various End Uses.

Fig. 3_c shows Fibres Recovery From Mixed Rag.

The process upto carding is almost the same as in every spinning mill, specially in worsted spinning. After carding the typical nonwoven process starts, because instead of sliver making at this stage, the web is transported in full width over a transport lattice of a cross-lapper. The main functions of a cross-lapper are firstly to determine the laying width and secondly to determine the area weight by laying many layers over each other. This comparatively voluminous and unstable structure is called now batt (also called lap or blanket). This batt is fed now over a special feeding system to a needle loom where it can be mechanically consolidated (by needling). The needling is done with the help of barbed felting needles without the help of any other foreign material, e.g. no thread or filament is used during this process. Depending on final product requirements, the needling has to be done sometimes in various passages, and the felt is generally turned upside down after every passage.

3.2. Waste fibre processing:

By processing waste fibres, some special machinery is necessary before the fibres can be carded since the waste fibres cannot always be defined in terms of fibre parameters and also the quality of such fibres only for limited end uses. In most of the uses, the needle felt made is not visible directly and is also not subjected to intensive wear and tear. Care has to be taken that fibres length should vary between 40-100 mm, though small share of shorter or longer fibres does not make any problem. Cotton waste for this reason cannot be needle felted alone because the cotton fibre droppings, stipper waste or noils, are too short.

3.3. Typcial sources of waste:

- soft and hard waste from spinning, weaving and knitting mills.
- manufacturers waste coming from man-made fibre plants.
- regenerated waste out of edge-cuttings of nonwoven industry.
- reclaimed waste out of used appareil fabrics, specially of wool or wool/synthetic origin (so-called shoddy). Shoddy can also be made out of cuttings of garment manufacturing industry.
- miscellaneous waste.

3.4. Machines requirements:

Cutter

Taking for granted that waste is available from multiple resources. The first machine required is a cutting machine, to cut the fibres or yarns in a suitable fibre length. Such machines work generally with 2 or 4 knives, working based on seissor movement to assure clean cuts. The cutting length is infinitely variable by means of speed variator. Such cutters are high production machines and can process between 1000-5000 kgs/hour depending on the working width of the machine, material and cutting length etc. The power requirements vary between 10-25 kW.

3.5. Tearing Machine (fibre reclaiming machine):

These machines possess big drums (cylinders) mounted with a large number of pin legs. The number of drums may vary between 1 and 6 drums wheres the number of pinning becomes higher and higher from 1st to subsequent drum. At the same time the pin size becomes finer. In fact the number of drums depends on the available waste and the required opening grade. For mixed waste of various origins and for a sufficient opening a machine with four cylinders is enough for most of the cases. These machines are also available in working widths between 600 - 1500 mm. The hourly production depends primarily on the raw material and machine working width, whereas the opening grade depends mainly on the number of cylinders. As such production rates between 100 kgs and 1000 kgs/hour are possible.

Generally it is also possible to take out the opened material after each cylinder. The power requirements vary between 50 kW to 170 kW by smaller machines and upto approx. 350 kW by broader machines.

3.6 Carding:

Woollen cards with workers and strippers are most suitable for proper web makir Modern cards are high-production cards for hourly production of 300 - 500 kgs/hour. The card production depends on the working width and fibre fineness. It is recommended to install a card with a working width of 2000 or 2500 mm. In this way it is possible to balance the production of a card with that of a needle loom plant. Generally a single cylinder card with sufficient number of worker and stripper rollers can produce a good quality web. Many people prefer to have two or more cards with intermediate lap building. Principally it is also possible to use an aerodynamic method of web making. The blending, fibre opening is, however, not comparable with carding process. This process is more suitable for heavy weight (gsm) felts and shorter fibres. The production rate is also much higher of these machines.

3.7. Cross lapper:

The web mede of a card, irrespective of its width, can be laid now in any desired width with the help of a cross-lapper. Due to large difference between web delivery speed and running speed of the cross-belt of a cross-lapper, many layers can be laid over each other. The batt weight depends on this speed difference and the area weight of the web. Manufacturers of the cross-lapper recommend a minimum number of web layers to avoid irregularities and so-called roofing effect in the batt. One should note that due to cross-lapping the production direction is changed automatically by 90^0. It is for this reason that the machine layout is always in L-form.

3.8. Needle Looms:

The batt made on a cross-lapper is yet very voluminous and unstable and has to be fed to a needle loom through a special feeding system which gradually consolidates the batt before it enters the needling zone. A two needle board machine with max. 4000 needles/1 m working width is recommended for these types of fibres. The machine should be a downstroke machine, i.e. the needling takes place from top to bottom. For degree of consolidation, parameters like needle size, depth of needle penetration and advance per stroke are determining factors. Following formula is valid for adjusting the punching density:

$$\text{punching density (punches/m}^2\text{)} = \frac{\text{No. of needles/1 m working width}}{\text{advance/stroke (mm)} \times 10}$$

Punching densities between 50 - 80 stitches/cm^2 impart the batt sufficient strength and the volume is reduced considerable.

3.9. Intensity of needling:

Mechanical consolidation through needle felting is done in steps, so-called needling passages, in cases where high material density is desired. Needle Looms are available for downstroke and upstroke needling. The number of boards in a machine and consequently the number of needles on 1 m working width depends on the machine type. For multi-purpose plant, it is advisable to install a discontinous production line.

3.10. Finishing:

Most of the needle felted nonwovens require a finishing treatment before they can be actually used. By flat floor coverings a full-bath impregnation or a back-coating, eventually also a foam backing are common. For rough uses like exhibitions, public offices, stair cases, gangways, hotels and restauranta a comparatively hard quality with full-bath impreanation is advisable. For higher comfort and soft qualities often a foam coating is also done. Even tiles of 40 x 40 cm of 50 x 50 cm can be made either in selfsticking or selflaying qualities.

3.11. Variety of end-products:

A complete production line for needle felted products is not very labour intensive specially by comparing with the production rates. In fact more semi-skilled or skilled labour is necessary for running such a plant. There are less laborious jobs, rather more control functions and quality control. The major laborious work can be designated as the material feeding at the cutter or tearing machine. After the material is fed to a card, the further process upto the needling line is continuous and no material handling is required. The needle felted rolls, in diameters between 1000-1200 mm, are removed from the winder. Depending on the end-product requirements, it is also possible to cut the needled felts in pieces by replacing the winder with a guillotine.

Following man power requirement can be considered as guide line:

material handling:	unskilled	-1
	semi-skilled	-1
cutter, material feeding:	semi-skilled	-1
tearing machine:	semi-skilled	-1
carding/cross lapping:	skilled	-1
needle looms:	skilled	-1

for supervisory function, quality control and machine adjustment, one head jobber for all the machines is necessary. Moreover, if no central electric department is available, the presence of one electrician in each shift is required for on the spot services.

3.12. Plant capacity:

By calculation of plant capacity, two major factors should be considered:
- hourly production by weight (kgs/hour)
- hourly production by area (sq.m/hour).

For heavy area weights, the card capacity is determining factor. Depending on the opening grade and fibre fineness, a modern card gives in 2500 mm working width approx. 300-500 kgs/hour. By heavy weights, the total production in sq. meter will be much less.

By a needle felt of 800 g/m^2 and card production of 350 kgs/hour, following production can be expected:

$$\frac{350}{0,6} = \text{approx. } 580\ m^2/\text{hour}$$

Linear speed of the needle loom.
(working width being 2500 mm,
felt width after edge-cutting 2000 mm) approx. 4,83 m/min.
At this production speed and at 1000 spm of the needle loom a punching density of approx. 80 $stitches/cm^2$ can be expected.

By light weight fabrics, e.g. 200 g/m^2, the [illegible]ar speed can be three times, and consequently the punching d[illegible] only one third. Suppose a punching density of 60 stitche[illegible] is necessary in a product, the production will be as follows:

No. of needles/1 m working width:	4000
advanoe per stroke (at punching density 60 st/cm^2):	6,7 mm
linear speed at 1000 spm:	6,7 m/min[illegible]
production per hour (final product with being 2000 2000 mm):	804 m^2/hour
production in kg/hour:	804 x 0,2 = 180,8 kg/hour

This example shows that inspite of the fact that linear speed and consequently the total production in sq. meter per hour i[illegible] higher, the production by waight is just the half.

As a general rule, one should take the max. possible production is the hourly production of a card. For light weight fabrics, however, the punching density and the produotion of needle loom ara determining factors. One should also consider that the card production has to be reduced in any case due to the light weight web, because a minimum number of layers have to be laid over each other to obtain a regular batt.

3.13. Investment:

For anybody planning to install such a plant, this is of course the major question. As already mentioned, such a plant is a high-production plant and for investment purposes, let's plan only one production line. In this case it is sufficient to install the cutting and tearing machine in the smallest working widths and as such for lowest capacity.

The prices of such machines differ from manufacturer to manufacturer. As rough guide line, the investment is as follows (all prices fob German port):

	lower capacity (1000-2500 kgs/hr)	medium capacity (3000 5000 kgs/hr)
1 rotary cutter	DM 86.000,	DM 134.000,
1 tearing machine	DM 350.000,	DM 520.000
	DM 436.000,	DM 654.000,

1 card, working width 2500 mm with volumetric feeding, e.g. vibra feed	DM 340.000,--
1 cross-lapper (flat-type)	DM 190.000,--
1 needle loom working width 2500 mm incle. special feeding system	DM 316.000,--
1 winding and cutting equipment	DM 66.000,--
total guiding costs fob German port	DM 1.348.000,--

ClF costs, ection charges and local taxes (import duty, local taxes etc.) are not included in above mentioned cost structure.

Additional equipment like fibre extinguisher, metal detector, lubericatıon unit and filter plant have to be installed extra. Such equipments are generally available indigenously.

total investment for a lower capacity plant: DM 1.348.000,
total investment for a medium capacity plant: DM 1.566.000,

The cost of the low capacity plant can be reduced if a card of 2000 min. working width is installed.

The cost of a finishign line is not included in the above list, since the finishing line entirely depends upon the end product requirements. In some cases no after treatment is necessary, while in others either calandering, full-bath impragnation or back coating may be necessary.

Note

The prices given here are those of 1986.

3.14. Survey of Nonwovens Applicatione:

Nonwoven textile find successful applications practically in all classes and subclasses shown in Table 1 (9).

4- Education and Training Center for Nonwoven Fabric Production and It's Uses:

The project will have the following objectives:

(a) to educate pepole about nonwovens especially in the industry and technical schools.
(b) to assist the Textile Industry in establishing a training centre with an annual through out of about (50) trainers for nonwovens (NW*) and ready-made clothing industries, at El-Mansoura district.
(c) to train the necessary instructors who will in turn train specialists and skilled workers in operation and maintenance of NW machines and other mechanical equipments.
(d) to train foremen, in plant-instructors and technicians in the techniques of supervision and the instruction of production and maintenance personnel.

Table I. Division of nonwoven textiles according to their end-uses .

Class	No.	Subclass
Waddings and paddings	1	Sanitary articles (cotton wools, waddings and tompons)
	2	Apparel paddings
	3	Furniture paddings
Thermal insulation materials	4	Packing and wrapping materials (e.g. for machines and instruments)
	5	Industrial thermal and acoustic insulotions
	6	Building thermal and acoustic insulations
	7	Apparel warmth-retaining interlinings. Vatelines
		Vatelines
		Kalmuks
Reinforcing materials	8	Reinforcements for shoes and leatherware
		Interlinings
		Stiffenings for shoes
		Stiffenings for heels
		Stiffenings for leatherware
		Stiffenings for bookbindings
	9	Stiffenings for underwear
		Stiffenings for shirt collars
	10	Apparel interlinings far tailors
		Replacements for cotton woven fa[illegible]
		Replacements for flax and [illegible] ven fabrics
		Resilient apparel interlinings
		Stiffening interlinings
		Horsehoir interlinings
Linings	11	Linings
		Linings for leatherware
		Linings for shose
		Linings for apparel
Decorative textiles	12	Decorative textiles and curtoins
	13	Curtnins
	14	Ribbons
Utility materials	15	Disposable handkerchiefs
Household materials	16	Tea towels, drying cloths
	17	Towels
	18	Tablecloths, napkins
	19	Bed linen
Industrial and technical materials	20	Covers, tarpaulins
	21	Base fabrics for tufted carpets
		Base fabrics for needled felts
		Base fabrics far plastic coatings
		Base fabrics for leather cloths
		Base fabrics for floorings
		Base fabrics for electrical insulations
		Base fabrics for water proof insulations
	22	Papermakers' felt blankets
	23	Filters
		Filters for liquids
		Filters for dusts, powders and solid particles
Household textiles	24	Upholstery fabrics
	25	Carpets
Wearing apparel	26	Industrial and protective clothing
	27	Underwear
	28	Replacement for yardage felts
		for decorative uses
		far apparel applications
	29	Shawls and scarves
	30	Textiles for shoe uppers
	31	Blankets
	32	Plushes and pile fabrics
	33	Light-weight outerwear fabrics
	34	Winter coat fabrics
	35	Ladies' dress fabrics
	36	Men's suitings
	37	Artificial furs
	38	Children's dress fabrics

industries used for producing textile fabrics. Products could be produced directly from these wastes, instead of remanufacturing some of these wastes to yarns (such as condensed yarns), through the long and ledious classical route of producing textile fabric.

13- For the time being in Egypt and because of the higher wages in the agricultural sector, the farmers do not give attention to the second picking (El-Tawani) of cotton, and they leave it in the fields, and goes aa waste with the cotton tree. The ministry of industry with co-operation with the ministry of agriculture could save this waste wealth, by encoureging the farmers to pick these cottons, and use it as a source of raw material to the proposed new industry, i.e. nonwoven industry.

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