UNLOCK NETWORKING EVENT: Advancing Circular Economy In Agriculture

TUESDAY 22 OCTOBER 2024 | 14:30-18:15 CET | BRUSSELS

This project has received funding from the Bio-based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 101023306. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

DEMONSTRATION OF BIODEGRADABLE AGRICULTURAL PRODUCTS FROM UNLOCK PRESENTATION OF PROTOTYPES AND THEIR DEVELOPMENT AND PRACTICAL APPLICATION AND BENEFITS

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Nonwoven by needle punching

Lukasiewicz - LIT

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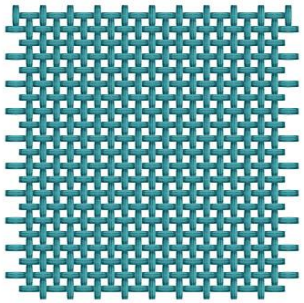
NONWOVEN BY NEEDLE PUNCHING

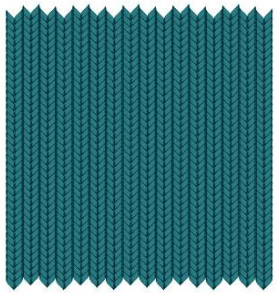
NONWOVEN

A type of fabric or material that is produced without weaving or knitting. Unlike traditional textiles that are made by interlacing yarns, nonwoven fabrics are created by bonding or entangling fibers together through mechanical, thermal, or chemical processes.

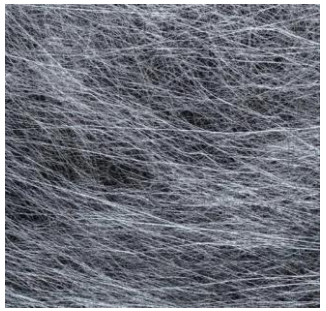
Fabrication methods: Nonwoven materials are made by processes like felting, needle punching, thermal bonding, or chemical bonding.



Fabric



Knitted fabric



Nonwoven

https://textilpedia.pl/tkanina-a-dzianina-roznice/

NONWOVEN BY NEEDLE PUNCHING

NEEDLE PUNCHING

A physical method of mechanically interlocking fibres webs by using barbed needles to reposition some of the fibres from a horizontal to a vertical orientation. Thousands of needles interlock fibers in a web.

ADVANTAGES OF NEEDLE PUNCHING:

- **Environmental friendliness:** The needle punching process is mechanical and does not require the use of water or chemical substances, making it more environmentally friendly.

- **Versatility:** Needle punching machines can process a wide range of fibers, both natural (e.g., wool, cotton) and synthetic (e.g., polyester, polypropylene).

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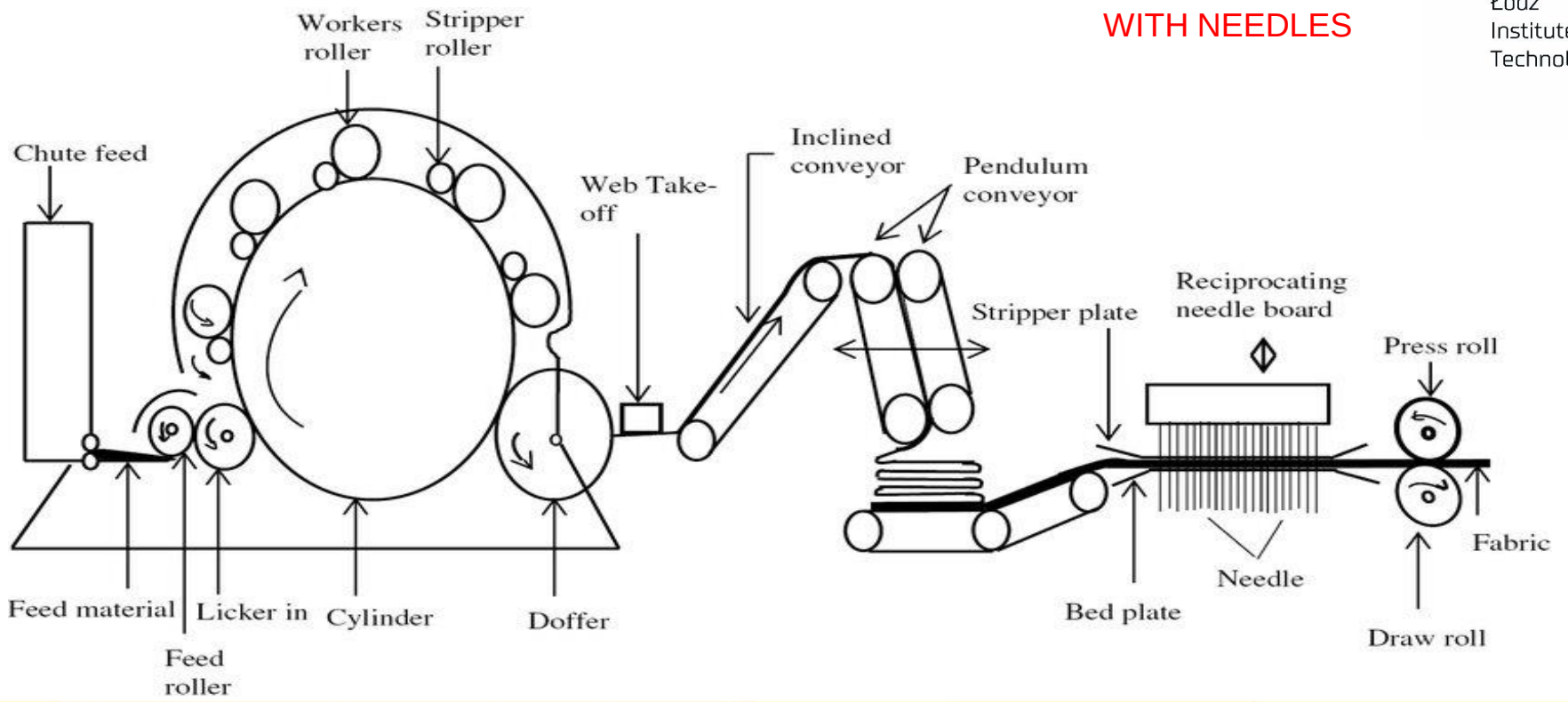
NONWOVEN BY NEEDLE PUNCHING

SCHEMATIC DIAGRAM OF NEEDLE PUNCHING NONWOVEN MACHINE

FORMER CARDING MACHINE CROSS-LAPPER MOVING PLATE WITH NEEDLES



https://www.researchgate.net/figure/Schematic-diagram-of-needle-punching-nonwoven-machine_fig1_309275416

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NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS

1. Fiber opener and blender

- Fiber loosening: The raw fibers fed into the machine may be compressed or entangled. The machine separates these fibers, making them easier to process in the next steps.

- Fiber blending: Fibers from different sources or with different properties can be mixed to create a homogeneous fiber mass. This is especially important in the production of nonwovens, where achieving uniform material properties across the entire surface is essential.

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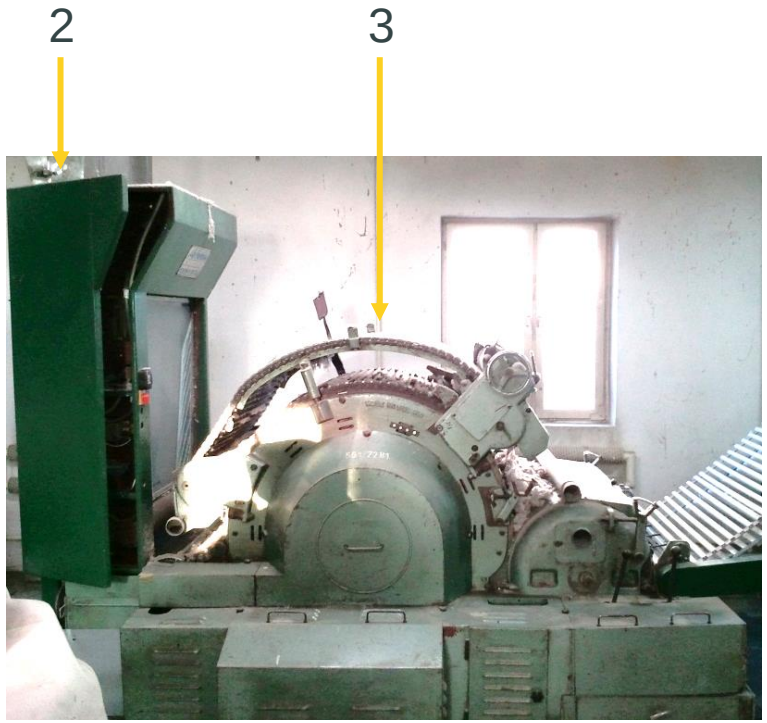
NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS



2. Former

Web formation: The former distributes loose fibers to create an even layer of nonwoven fabric (web). The fibers are precisely arranged to achieve the desired thickness and uniformity of the material's structure.

3. Carding machine

- Fiber combing: c.m. separates fibers into individual strands, eliminating tangles and fiber clumps. This results in an even distribution of fibers, which is essential for the quality of the final product.
- Fiber orientation control: c.m. aligns fibers in one direction, which influences the strength and flexibility of the resulting material.

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NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS

4. Dispenser

The dispenser's task is to introduce properly prepared poultry feathers by sprinkling them onto a single fiber web coming out of the carding machine. It is equipped with speed control of the dosing rollers, ensuring regulation of the number of feathers added.

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NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS

5. Cross-lapper

Behind the dispenser, the feather-laden webs are layered on top of each other (lapped) using a cross-lapper. This ensures that the feathers are enclosed within the structure of the nonwoven

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NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS

5. Needle punching machine (needle loom)

consists of a moving plate equipped with 1600 of needles. These needles perform rapid up-and-down movements, piercing the nonwoven fabric placed on a special base plate. This process leads to the mechanical entanglement of the fibers, and the final effect depends on the number of needle strikes per minute.

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NONWOVEN BY NEEDLE PUNCHING

STEPS IN THE MANUFACTURING OF NEEDLE-PUNCHED NONWOVENS

6. Calender

Its task is the thermal consolidation of the nonwoven fabric by heating, softening, and bonding the PLA fibers. This process allows for the enclosure of feathers within the structure and improves the strength properties. The calender is equipped with rotating heating rollers, between which the nonwoven fabric is passed. The speed ranges from 0.5 m/min to 11 m/min, and the heating range is to 200°C.

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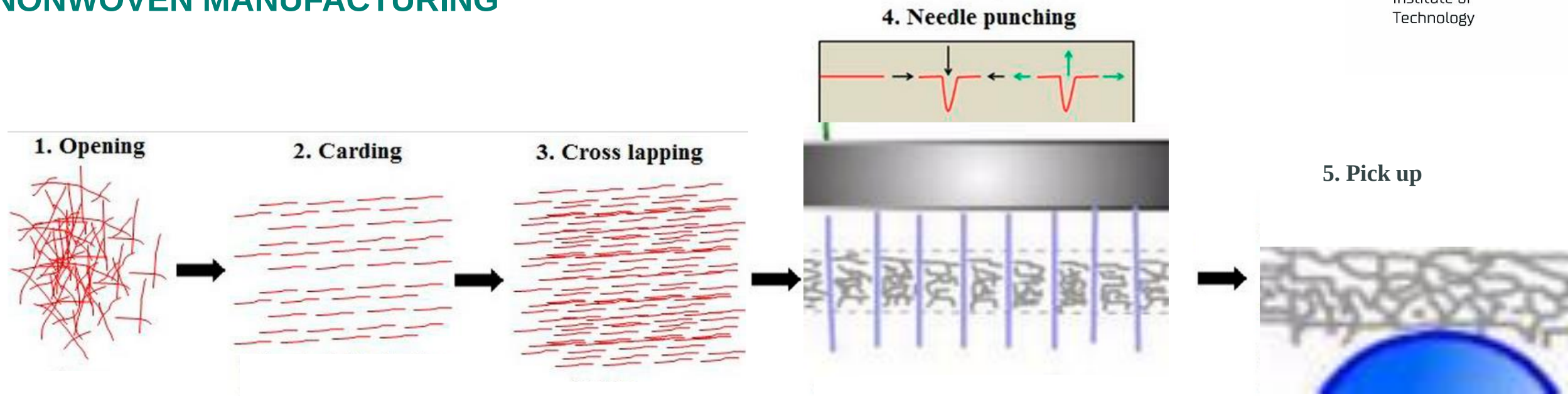
NONWOVEN BY NEEDLE PUNCHING

SCHEMATIC DIAGRAM OF NEEDLE PUNCHING NONWOVEN MANUFACTURING



Fibres

Fibre individualisation and parallelisation

Web

Fibre entanglement & consolidation

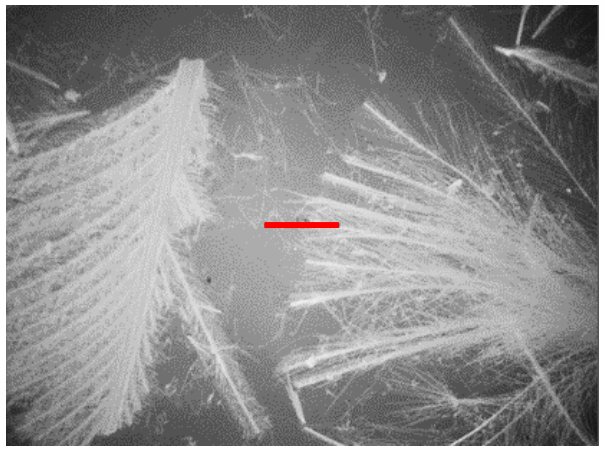
Final nonwoven

https://www.researchgate.net/publication/358644051_Evaluation_of_structural_integrity_of_needle_punched_banana_fiber_reinforced_industrial_safety_helmets
https://www.researchgate.net/publication/353034321_Development_of_Needle-Punched_Nonwoven_Fabrics_from_Natural_Fibers_for_Sound_Absorption_Behavior

NONWOVEN BY NEEDLE PUNCHING

DESCRIPTION OF THE DEVELOPED PROTOTYPE

Characteristic	Value
Basic polymer	**PLA** 100% or **PLA/cotton** (up to 50/50)
Feather formulation	Clean, sterilised, feathers, shredded e.g. by Cedrob
Feather concentration in nonwoven	20-50% (w/w)
Basis weight g/m^2	100-200 (max. 400)
Feather size	Main fraction (1-15 mm) content– min. 50% Other fractions - smaller
Nonwoven stabilisation method	Calendering Take-up speed: 2.0 -2.5 m/min Temp: 140 - 150°C



Bar on figure – 1mm

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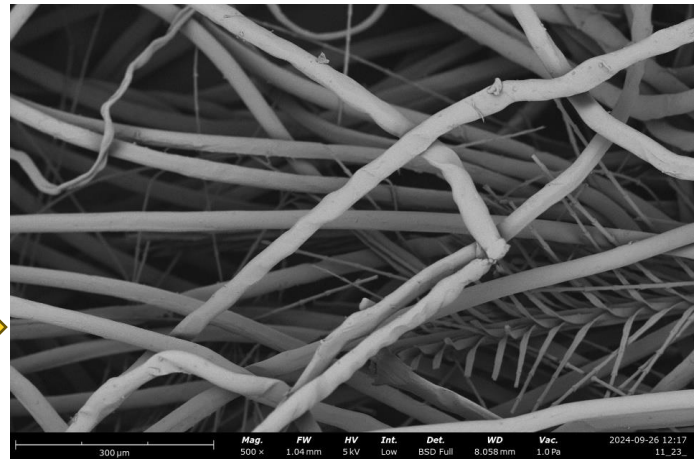
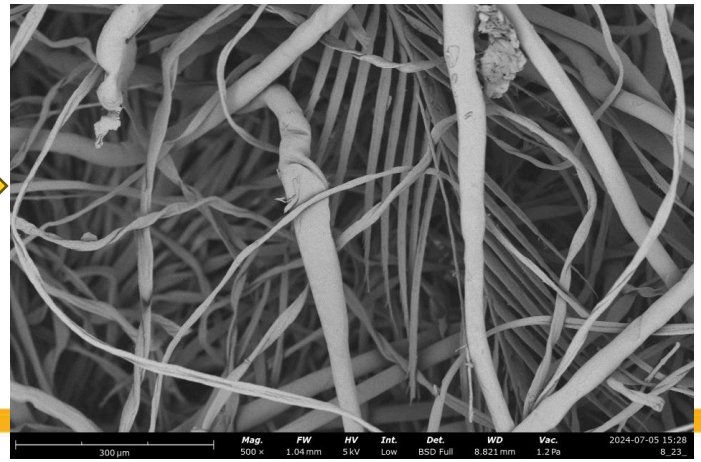
NONWOVEN BY NEEDLE PUNCHING

DESCRIPTION OF THE DEVELOPED PROTOTYPE

L-LIT can produce a nonwovens 1m wide, with a maximum capacity of 70 - 100m per week.





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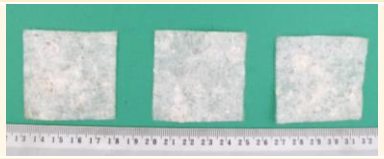
NONWOVEN BY NEEDLE PUNCHING

BIODEGRADATION IN SOIL ENVIROMENT

Determination of the degree of degradation of plastics and textile products under simulated soil conditions on a laboratory scale. Method for determining weight loss.

Sample no.	Composition, %			Weight loss after 24 weeks	Photo documentation	
	Feathers	PLA	Cotton	%	Initial	After 24 weeks
1 UN/23	20	80	-	24.7		
3 UN/23	30	35	35	69.7		
4 UN/23	35	32.5	32.5	74.3		

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PCA
POLSKIE CENTRUM AKREDYTACJI
BADANIA
AB 388

Related standards:
PN-EN ISO 11266:2020-11
PN-EN ISO 11721-1:2002
PN-EN ISO 11721-2:2005.

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NONWOVEN BY NEEDLE PUNCHING

BIODEGRADATION IN SOIL ENVIROMENT

Evaluation of the impact of natural and synthetic materials on soil microflora

Sample no.	Composition, %			Control		Tested sample	
	Feathers	PLA	Cotton	Initial	After 24 weeks	Initial	After 24 weeks
				Colony-forming units, CFU/g			
1 UN/23	20	80	-	1.2×10^6	1.9×10^5	1.2×10^6	2.9×10^5
3 UN/23	30	35	35	1.1×10^6	1.5×10^5	1.1×10^6	1.3×10^5
4 UN/23	35	32.5	32.5	1.1×10^6	1.5×10^5	1.1×10^6	2.8×10^5

AB 388

Related standards:
PN-EN ISO 7218:2008
PN-EN ISO 11133:2014-07/A1
PN-EN ISO 4833-1:2013-12
PN-EN ISO 19036:2011

NONWOVEN BY NEEDLE PUNCHING

TEST IN FIELD

- Lettuce achieve an excellent performance in 5- 6 weeks.
- Nonwoven tissue remains compacted after 6 weeks, there isn't any break, and it remain perfect instead strong rains.
- There are some weeds bellowed nonvowen tissue.

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NONWOVEN BY NEEDLE PUNCHING

ADVANTAGES OF THE NONWOVENS DESIGNED

- biodegradability
- possibility to control the biodegradation time by choosing the proportion of ingredients
- disposal of waste feathers
- provision of nutrients for plants
- possibility of forming seed pots

PRACTICAL APPLICATIONS

As an agro-woven fabric for growing vegetables, fruit, flowers, with protective, heat insulating, fertilising applications.

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