

THE RESEARCH of the FELT FULLING PROCESS from the COARSE SHEEP WOOL

Ye. O. Rensevych
jek6566@gmail.com

Zaporizhzhia Research Center of Mechanization of Animal Breeding of the
National Scientific Center – “Mechanization and Electrification
of Agriculture Institute”
14, Entusiastiv Street, Chortytsia district, Zaporizhzhia, 69097, Ukraine

V. S. Yakovchuk
ascitsr_zavlabtehnolog@ukr.net

Ascania Nova Institute of Animal Breeding in the Steppe Regions
Named after M. F. Ivanov – National Scientific Selection-Genetics
Center for Sheep Breeding
1, Soborna Street, Askania Nova, Chaplynka district,
Kherson region, 75230, Ukraine

The results of studies the felt fulling process from coarse sheep wool are given. It is established that the process of felting has a nonlinear logarithmic character, and the felt becomes the most density during the first 15 minutes this process. After this, the fulling process becomes almost linear. When using a plate-type felting machine to increase the productivity of felting, it is necessary to increase the power, the vibrations amplitude and the plate area. To achieve these parameters, a crank mechanism should be used which has the following production characteristics: vibration 500 rpm, power 1 kW and amplitude 4-24 mm, and plate area 0.8 x 1.8 m.

Keywords: felt, wool, felting process, plate, vibrator, pressure

ДОСЛІДЖЕННЯ ПРОЦЕСУ ВАЛЯННЯ ПОВСТІ З ГРУБОЇ ОВЕЧОЇ ВОВНИ

Є. О. Ренсевич
jek6566@gmail.com

Запорізький науково-дослідний центр з механізації тваринництва
Національного наукового центру «Інститут механізації та
електрифікації сільського господарства»
вул. Ентузіастів 14, м. Запоріжжя, Хортицький р-н, Україна, 69097

В. С. Яковчук
ascitsr_zavlabtehnolog@ukr.net

Інститут тваринництва степових районів імені М. Ф. Іванова
«Асканія-Нова» - Національний науковий селекційно-генетичний
центр з вівчарства
вул. Соборна, 1, смт Асканія-Нова, Чаплинський р-н,
Херсонська обл., 75230, Україна

*Наведено результати досліджень валяння повсті з грубої
вовни. Встановлено, що процес валяння має нелінійний логариф-
мічний характер, і більшу частину щільності повсть набуває за
перші 15 хвилин. Після цього процес валки стає практично ліній-
ним. Для збільшення продуктивності процесу валяння на плитній
валяльній машині необхідно підвищувати потужність, амплітуду
вібрацій і площу плити – застосовувати кривошипний механізм до
500 об/хв. при потужності 1 кВт та амплітуді 4-24 мм, і
площі плити 0,8 x 1,8 м.*

Ключові слова: повсть, вовна, валяння, плита, вібратор, тиск.

ИССЛЕДОВАНИЕ ПРОЦЕССА ВАЛЯНИЯ ВОЙЛОКА ИЗ ГРУБОЙ ОВЕЧЬЕЙ ШЕРСТИ

Е. А. Ренсевич
jek6566@gmail.com

Запорожский научно-исследовательский центр механизации
животноводства Национального научного центра «Институт
механизации и электрификации сельского хозяйства»
ул. Энтузиастов 14, г. Запорожье, Хортицкий р-н, Украина, 69097

В. С. Яковчук
ascitsr_zavlabtehnolog@ukr.net

Институт животноводства степных районов имени М. Ф. Иванова
«Аскания-Нова» - Национальный научный селекционно-
генетический центр по овцеводству
ул. Соборная, 1, пгт. Аскания-Нова, Чаплинский р-н,
Херсонская обл., 75230, Украина

Приведены результаты исследований валяния войлока из грубой овечьей шерсти. Установлено, что процесс валяния имеет нелинейный логарифмический характер, и большую часть плотности войлок приобретает в первые 15 минут данного процесса. После этого процесс валки становится практически линейным. Для увеличения продуктивности валяния на плитной валяльной машине необходимо повышать мощность, амплитуду вибраций и площадь плиты – применять кривошипный механизм, имеющий вибрации 500 об/мин., мощность 1кВт и амплитуду 4-24 мм, а площадь плиты – 0,8 х 1,8 м.

Ключевые слова: войлок, шерсть, процесс валяния, плита, вибратор, давление.

According to the data of Association Ukrainian sheep and goats breeders, the volume of unclaimed wool for today in Ukraine is 3610 tons, including 530 tons of coarse wool. However, with the processing of this wool there are certain problems: it either is sold at a low price, or is not used at all for its intended purpose. In industrial quantities, coarse wool is processed into felt on the production lines [1,2]. The processing of coarse wool on the farms is not carried out or is carried out by hand-craft method - heavy manual and unproductive labor (1 pair of felt boots or 2 kg of wool during 1-3 days).

Now there are no simple small-sized machines for processing wool and getting the felt from coarse wool. Their creation will allow producing inexpensive felt products directly in the individual and private farms, will contribute to increasing the industry profitability, and will satisfy the needs of the population. The felt is a natural, environmentally friendly product, it is used for treatment of rheumatism, it's a warming material, and as heat and sound insulation, saddle, filtering materials, etc.

In the ZRCMAB, in cooperation with the "Askania-Nova" IABSR, an experimental felting machine PFM-1 (plate-type felting machine) was developed on the basis of which it is possible to build a mathematical model of the process, determine the main influencing factors and optimal construction of the felting mechanism, parameters of felted samples.

The material and the method of researches. The investigation of the felting process the felt from coarse combing wool was carried out on an experimental felting machine PFM-1 in accordance with Fig. 1.

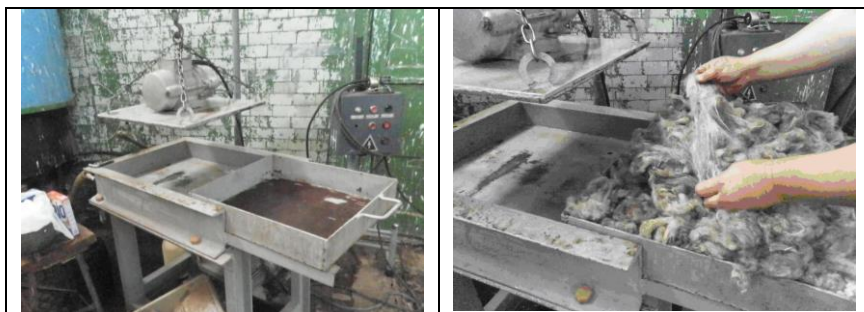


Fig. 1. The investigation of the wool felting by the felting machine PFM-1.

Table 1. Technical characteristics of the felting machine PFM-1

Index	Value
Productivity, kg / h	0,5-2
Power, kW	0,3
Service staff, person	1
Overall dimensions, mm, not more	1210x910x1800
Total mass, kg, no more	225
Felt overall dimensions, mm	500x500
- thickness	up to 30
Fulling temperature, °C	up to +70
Duration of the process, min	15-60

The wool, which has been combed to the state of wadding, also cleaned and washed was loaded into the pallet of the machine where, in a solution of soda and detergent powder, heated to a temperature of 70°C, in a moistened state, under the pressure of a vibrating top plate with transverse grooves, gradually becomes into the felt.

The felting process in accordance with Figure 2 was carried out with interruptions for wetting and turn over the samples, as only the side that

is pressed by the top vibrating plate was felted more strongly. At the end of the felting, samples were rinsed with hot water.



Fig. 2. The felting process of the wool

After the felting, the samples were dried in air at the temperature of + 40 ° C until moisture was removed, and in the end at + 80 ° C in the drying cabinet.

The researches results. On the obtained felt samples, the felt density ρ was determined - the initial function of the mathematical model of the process - through measuring the geometric dimensions, width, length and mass of the samples in accordance with Figure 3.



Fig. 3. The samples of felt

The analysis of the felting process on the machine PFM-1, taking into account the initial density of the wool, shows that, as a whole, it has a nonlinear character and the most part of the density is felt in the first 15 minutes - this is the minimum felting time in accordance with Figure 4. After this, the felting process becomes almost linear.

With an area of 1000 cm² and a plate weight of 45 kg with a plate pressure of 45 g / cm², 0.15 g / cm³ felt density was obtained. In addition, for an area of 2500 cm² and a plate weight of 42 kg with a pressure of 16 g / cm², it was obtained no more than 0.11 g / cm³ density. The factory samples density of 0.15-0.2 g / cm³ and maximum ones up to 0.4 g / cm³.

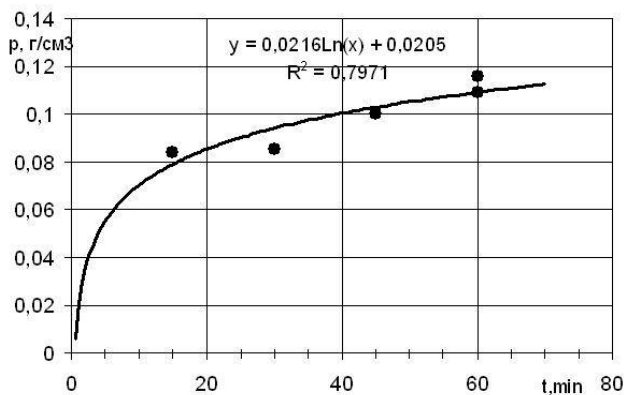


Рис. 4. Загальний характер процесу валяння повсті

The reason for this is the weak action of the vibrator plate on the wool layer - a decrease in the vibration amplitude is caused by the large plate area. When increasing the area, it is necessary to increase the pressure, drive power and the weight of unbalanced loads. To achieve high performance, the plate amplitude oscillation should be proportional to the thickness of the sample [1, 2].

The cost of processing in a dense felt 1 kg per hour is 30 UAH / kg: hot water, incl. for washing from contamination - 50 l / kg, detergent powder - up to 100 g, soda - 100 g, electricity - 1 kWh.

Conclusions. The plate-type felting machine can produce the insulation, which made from the coarse wool, and has the form of felt plate-square 50x50 cm for in size 2-3 cm thick with a density of 0.08-0.11 g / cm³ and weighing 0.7-0.76 kg during 0.5 or 1 hour.

The process of felting has a nonlinear logarithmic character, and the felt becomes the most density during the first 15 minutes this process - that is the minimum felting time. After this, the felting process becomes practically linear.

For the significantly increase productivity and increase the plate area, it is necessary to increase the amplitude of the oscillations and the impact power of the plate, its area; that can be achieved by increasing

the size of the plate or by felting the rolls under the impact power of the mechanism.

In addition, to increase the productivity of the felting process on the plate-type felting machine, it is necessary to increase its power, the amplitude of the vibrations and the area of the plate. To do this, a crank mechanism must be used which has up to 500 rpm at a power of 1 kW, an amplitude of 4-24 mm, and a plate area of 0.8x1.8 m. In addition, it is possible to develop a roll-felting machine for felting a much larger felt - up to 1-1.5 m in width and up to 2-3 m in length.

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