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A Study of Mechanical Properties and Morphology Domba Wonosobo (Dombos) Fibre

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Abstract: This paper reports the structure and most significant parameters of fibre from dombos in Wonosobo, Central java, Indonesia. Dombos is a mixbreed or crossbreed between domestic sheep from Wonosobo and texel sheep from Netherlands. Dombos has unique hairs, that cannot be utilized to be wool fibre. The external and internal structures of the fibre were evaluated based on microscopic observations of the fineness and cross sections. It was determined that both the surfaces and cross sections of the dombos fibres are shown. The aim of this study is to analize the special characteristic of dombos fibre. The mechanical properties such as fibre length, fineness and tenacity of dombos fibre are evaluated.

Keywords : fibres, wool fibre, dombos fibre,mechanical properties, morphology of fibre
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1. Introduction

Wonosobo sheep or dombos are genetically originated from Central Java such as Kejajar, Garung, Kalijajar, Mojotengah, Watumalang, and Kertek. This dombos can be raised in highland about 600m sea level above. In 2010, the population of dombos in the whole area of Central Java were 9808 (Muryanto, dkk., 2010). Dombos is a mixbreed or crossbreed between domestic sheep from wonosobo and texel sheep from Netherlands.

Although dombos has unique hairs, it is unfortunate that the hairs are not able to be used as wool fibre which caused a lot of waste. Local farmers usually burn the dombos hair and create another problem in the environment such as air pollution. A minor part of dombos hair are made use as pillow filling or burned. In fact, sheep hairs or fleeces were special part of sheep, it could be 1-2% of sheep total weight, however, domestic farmer nowadays cannot exploit the dombos fibre in cosideration of the dombos fibre features.

2. Materials and Methods

1.1 Materials

Material used for characterization is sorted dombos fibre. The sorting process is intended to separate the long and short fibres. Furthermore, the sorted fibres are cleaned of external impurities such as twigs, dirt, dust, soil and internal impurities such as fat to avoid the smell and arisen bacterias by scouring.

1.2 Micronaire

To get fineness in a unit of length quantity on dombos fibre, micronaire testing is needed which later results in the form of micron scale fineness using SNI ISO 2403:2010. This standard test is adopted by ISO/R 220 where the wool is one of the raw materials that can be used for this standard. Samples in this test are as much as 5.9 gram using shadowgraph. The setting of mercury is 2.25 cmHg, air pressure is 1.75 kg / cm^2 with an upper limit setting of 37.8 microns and a lower limit of 20.8 microns. The scheme of micronaire tester is shown in figure 1.

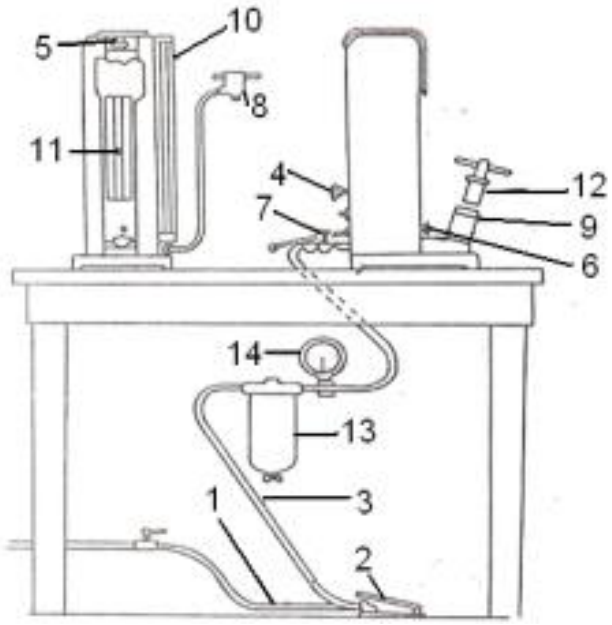

Figure 1. Scheme of micronaire tester

Notes :

1. Air in	8. Master plug
2. Foot controller	9. compression chamber fibre
3. Aair flux	10. Manometer
4. Pressure knop	11. Valuer
5. Guided knop	12. Compression plunger
6. Evaluator knop	13. Air filter
7. Air faucet	14. Manometer

1.3 Fibre Length

Fibre length of the dombos fibre was measured with SNI ISO 6989:2016 using 100 samples of dombos fibre.

1.4 Tensile Strength

The mechanical strength of the fibre was measured in accordance with the SNI ISO 3060:2010, this standard test is adopted by ISO/R 220 which the wool is one of the raw materials that can be used for this standard. The tensile strength and elongation at break of bundle fibres were determined with an stelometer at 65% R.H. and 21 ^{O}C using a 1/8 inch gauge length.

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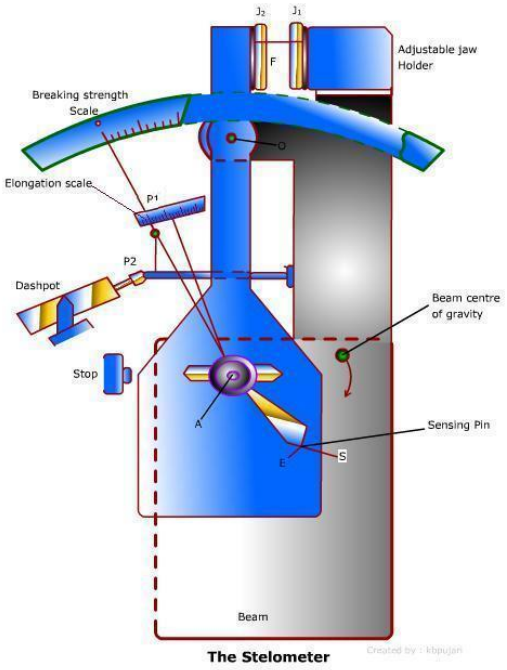

Figure 2. Scheme of stelometer

1.5 Moisture Regain

Moisture regain was measured on samples equilibrated at same relative humadities with temperatures 110 ^{O}C. The five samples (each weigthing about 3000 mg) were tested in mesdan incubator oven. This method used SNI 8100:2015 where exicator and glass storage for fibre are needed for additional evaluation.

1.6 Morphology

Fibre morphologies were examined using a microscope with scale 1:40 to see the cross section and longitudinal of the fibre. Integrated PC Microscope which is used to examine can be seen from figure 3.

Figure 3. Microscope integrated with PC

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3. Results

3.1. Mechanical Properties

In this research, the micronaire, fibre length and tensile strength are used for evaluation of mechanical properties.

3.1.1. Micronaire

From the micronaire test data, the average micronaire number shows the number of 28 mikrogram/inch with FC 0.85 and the result of fineness dombos fibre is 8.5 dtex. To achive the dtex, the formula is shown below:

$$\text{Fineness (microgram/inch)} = \text{Fineness average x FC} \quad (1)$$

$$\text{Fineness (militex)} = \text{Fineness average x } 39.37 \quad (2)$$

$$\text{Fineness (denier)} = \frac{Fineness\ average}{2.82} \quad (3)$$

$$\text{Fineness (dtex)} = \frac{10}{9}\ x\ Fineness\ (denier) \quad (4)$$

3.1.2. Fibre length

In table 1 there is data fibre length where it turns out that the produced average length is 156.5 mm resulting from the formula:

$$\text{FL (average)} = \frac{\Sigma FL\ x\ TF}{\Sigma TF} \quad (5)$$

Table 1. Data of fibre length

FL (mm)	TF	FL x TF (mm)
110	6	660
115	10	1150
120	10	1200
130	10	1300
135	15	2025
140	10	1400
145	10	1450
155	10	1550
165	10	1650
175	5	875
180	2	360
190	2	380
Σ	**100**	**15,650**

Notes:
FL = Fibre length
TF = Total Fibre

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With an average fibre length of 156.5 mm, this dombos fibre is included in the long fibre and is predicted to produce worsted yarn.

3.1.3. Tensile Strength

Tensile test results per bundle of dombos fibre can be seen in table 2 with CF values for the tenacity of 1.131 and 0.535 of CF elongation, which is where the tenacity value and elongation at break are generated from the formula:

$$\text{Tenacity (g/tex)} = \frac{BS}{W}\ x\ 14.9x\ CF \tag{6}$$

$$\text{Elongation at break (\%)} = \text{Elongation}\ data\ x\ \ CF \tag{7}$$

Tabel 2. Tenacity and elongation of dombos fibre

Breaking Strength (Kp)	Elongation data (%)	Elongation at break (%)	Weight of fibres (mg)	Tenacity (g/tex)
4.4	20.0	**10.70**	6.715	**11.04**
4.0	18.5	**9.89**	4.775	**16.85**
3.0	15.5	**8.29**	3.850	**13.13**
5.1	27.0	**14.44**	7.800	**11.02**
4.45	26.0	**13.91**	6.535	**11.47**
4.1	23.5	**12.57**	5.383	**12.83**
3.9	20.0	**10.70**	4.765	**13.79**
5.0	28.5	**15.24**	6.630	**12.71**
4.8	17.5	**9.36**	6.705	**12.06**
5.0	27.0	**14.44**	6.900	**12.12**
Average		**11.95**	**-**	**12.70**

3.2. Moisture Regain

Table 3 shows the moisture sorption of water for samples. The result indicates that the moisture regain of dombos fibre is 14.48%. The formula for moisture regain is:

$$\text{MR} = \frac{Gross\ weight - Dry\ weight}{Dry\ weight}\ x\ 100\% \tag{8}$$

Table 3. Moisture Regain of dombos fibre

Gross weight (mg)	Dry weight (mg)	MR (%)
3000	2573	16.6
3000	2638	13.7
3000	2636	13.8
3000	2650	13.2
3000	2605	15.1
Average		**14.48**

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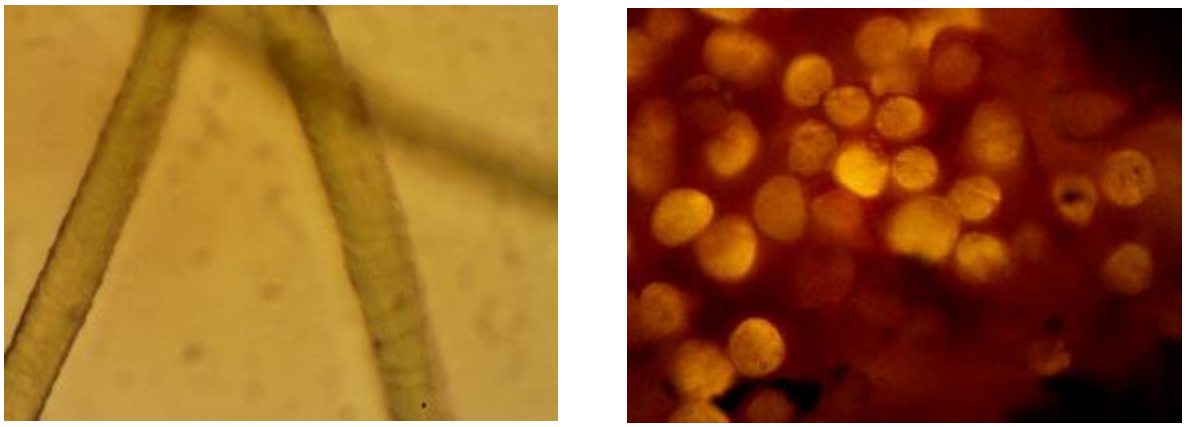
3.3. Cross Sectional of Dombos fibre

The cross section and longitudinal view of the microscope demostrates that the cross section of the fibre looks scaly, while the longitudinal cross section looks round but not evenly the same as the cross section of wool fibre in general. The cross section and longitudinal morphology test results can be seen in Figure 4.



(a) (b)

Figure 4. (a) Cross section dombos fibre, (b) Longitudinal cross section dombos fibre

4. Discussion

Since no one has discussed the dombos fibre characterization, this study has become the first to write. Being the prior to write this study, the initial data are meant to determine the mechanical and morphological properties of these dombos fibres, which are described as follows:

1. Data shows that the morphology of dombos fibres is same as wool in generaly.
2. The moisture regain was 14.48%, which indicated that the result was still below the moisture regain of wool.
3. The fibre is fine because the micronaire test results show 8.5 dtex, if spun into yarn it will be a very fine thread because the average fibre length is 156.5 mm.
4. From the data, the tenacity and stretch of this fibre will have good viscoelastic, but further research is needed in order to find out its viscoelastic properties.

5. Conclusion

In conclusion, the application of dombos fibre can be used not only for clothing, but also in the civil field as insulation panels and substitutes for heat insulators made of synthetic materials.

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