

UNITED STATES PATENT OFFICE.

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PROCESS FOR IMPROVING TENSILE STRENGTH OF FABRIC MATERIALS.

No Drawing.

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This invention relates to vegetable fibers having a high tensile strength and to processes for increasing the tensile strength of such fibers either before or after they have been woven or spun into fabric or other materials.

One of the objects of the invention is to increase the efficiency of cotton tape used for insulating purposes. Insulation for electric conductors is usually made from fibrous material and it is essential that the insulation be strong, for, if it becomes broken, the conductors carrying electric current will become exposed and considerable danger may result.

My invention, however is not limited to increasing the tensile strength of insulating material alone but relates broadly to the process of increasing the tensile strength of vegetable fibrous materials of all kinds and for whatever purpose used. In fabricating looms, for example, considerable difficulty is sometimes experienced by threads breaking in the looms during the process, and expensive loss results from the consequent necessity of stopping the operation of the looms while the broken threads are being repaired.

Other objects and advantages of the invention will appear as the description proceeds.

In experimenting with cotton tape used for insulating purposes, I have made the discovery that, if it is exposed to ozonized air at an elevated temperature, an increase in the tensile strength of the cotton fabric will result.

While the exact nature of the reaction between the vegetable fibers and ozonized air is not known, a chemical reaction probably takes place. The activity of the ozone may be explained by its tendency to break down at or above ordinary temperature, forming atomic or ionic oxygen in the nascent state. I do not, however, desire to limit myself to any particular theory that now prevails or may be later developed. A full disclosure of my experiments along this line will now be made.

I took a strip of cotton tape .007 inch thick and three-fourths inch wide and placed it in an electric oven of such construction that the

temperature of the cotton tape and of a current of air or a mixture of air and ozone passing through the oven could be regulated. A current of dry air was first passed through the oven at the rate of seven liters per minute for periods of eight, sixteen and thirty-two hours, and measurements of the tensile strength of the fabric was made at 10° temperature ranges from 110° to 150° centigrade. No increase in the tensile strength of the cotton tape was found; but, on the contrary, its tensile strength was slightly lowered by exposure to the heated air. 0.1 per cent of ozone was then added to the air, and the resulting mixture was again passed through the oven at the same rate of flow for the same periods of time and at the same temperature ranges as when air was used, and the striking discovery was made that the exposure of the fabric to the ozonized air caused an increase in tensile strength of the fabric of from 20 to 30 per cent.

Another sample of tape was next dipped in an oil varnish having a gummy or resinous base, the specific gravity of which was .851, and drained for fifteen minutes in the open air. The tape was then placed in an electrically heated oven and tests were again made, first using dry air and then using air to which 0.1 per cent of ozone has been added, the gas being passed through the oven at the rate of seven liters per minute and for the same periods of time as in the previous example. Tests were again made at 10° temperature ranges from 110° to 150° centigrade, and the results showed that, at temperatures from 110° to 130° centigrade, a varnished tape which has been exposed to ozonized air generally has a greater tensile strength than a varnished tape which has been exposed to a current of air at the same temperature.

In making the experiments, a Perkins tensile tester was used, and, in each case, a blank tensile strength test was made of the fabric before it was subjected to either the air or the ozone treatment, as it has been found that, frequently, there are variations in the tensile strength of different rolls of cotton tape.

The results of the above experiments are tabulated below:

Tensile strength tests.

[Break—pounds per square inch.]

Air bake			Ozone bake			
10	Time	Unvarnished tape	Varnished tape	Time	Unvarnished tape	Varnished tape
		—110° C.—			—110° C.—	
	Blank	49	-----	Blank	53	-----
	8 hours	48	76	8 hours	61	84
	16 hours	47	85	16 hours	64	93
	32 hours	46	93	32 hours	62	100
	—120° C.—		—120° C.—			
	Blank	49	-----	Blank	53	-----
20	8 hours	48	79	8 hours	63	84
	16 hours	45	88	16 hours	58	101
	32 hours	43	95	32 hours	56	103
	—130° C.—		—130° C.—			
	Blank	49	-----	Blank	54	-----
	8 hours	48	94	8 hours	59	99
	16 hours	45	103	16 hours	54	101
	32 hours	43	102	32 hours	50	109
	—140° C.—		—140° C.—			
	Blank	49	-----	Blank	49	-----
30	8 hours	49	96	8 hours	50	87
	16 hours	45	99	16 hours	42	89
	32 hours	40	97	32 hours	34	87
	—150° C.—		—150° C.—			
	Blank	48	-----	Blank	48	-----
	8 hours	40	82	8 hours	46	84
	16 hours	36	88	16 hours	34	89
	32 hours	28	77	32 hours	24	87

Experiments were also made at lower temperatures, and it was discovered that no increase in tensile strength could be obtained by ozone treatment at room temperature. At temperatures between 75° and 100° centigrade, however, the exposing of the fibrous material to ozonized air caused an increase in the tensile strength. This indicates that some heat is necessary to bring about the reaction and it has been found that a temperature of above 100° centigrade is advantageous in securing the best results. Other experiments demonstrate that, if the ozone concentration in the air flow is increased, the tensile strength will be increased in a much shorter time than when a lower concentration is used; for example, when the ozone concentration was increased to 0.5 per cent, the tensile strength of unvarnished cotton tape was increased over 20 per cent in one-half hour at 110° centigrade. If the temperature is increased, the ozone concentration may be decreased and the same results may be obtained; for instance, an increase of 20 percent in the tensile strength of unvarnished cotton tape may be obtained in one-half hour with an ozone con-

centration of 0.1 per cent by increasing the temperature to 150° centigrade.

I have also discovered that not only is the tensile strength of cotton fibers increased by this process, but the tensile strength of other vegetable fibrous material may also be increased in a like manner. Tests were made upon wrapping twine and upon elan flax Seine cord and it was found that, under proper treatment, an increase in tensile strength of from 20 to 25 per cent was obtained in the wrapping twine and an increase of about 23 per cent was obtained in the cord.

If desired, the twine or thread, or even the cotton tape, may be drawn slowly through the oven in a manner well known in the art, it only being necessary that the temperature of the fibrous material and the ozonized air be such that the desired reaction will take place at the proper ozone concentration. It will be understood that the term "oven", as used in the present specification and claims, includes not only an electrically heated oven but any kind of a container or receptacle heated by electric or other means of such nature that the fibrous material and ozonized air may be maintained at the proper temperature.

The term "elevated temperature", as used in the present specification and claims, means any temperature above room temperature and below the temperature at which the fibrous material begins to decompose.

In summarizing the results of the experiments on fibrous materials given above, it will be observed from the description and from the tables that three factors enter into the results; namely, temperature, ozone concentration and time, and these factors also vary with varnished and unvarnished fibrous materials.

While numerous examples have been given and I have described my method in considerable detail, I desire it to be understood that I do not limit myself to the exact examples given, but wish to claim broadly the idea of increasing the tensile strength of fibrous materials by exposing them to ozonized air at an elevated temperature.

I claim as my invention:

1. The process of increasing the tensile strength of vegetable fibrous material which comprises exposing the fibrous material to ozonized air at an elevated temperature.

2. The process of increasing the tensile strength of vegetable fibrous material which comprises exposing the fibrous material to ozonized air at such temperature that a reaction occurs between the vegetable fibrous material and the ozonized air.

3. The process of increasing the tensile strength of vegetable fibrous material which comprises placing vegetable fibrous material in an oven, passing ozonized air through the oven so that it will come in contact with the fibrous material and regulating the heat of

the oven so that the ozonized air and vegetable fibrous material will be maintained at an elevated temperature.

5 4. The process of increasing the tensile strength of vegetable fibrous material which comprises dipping vegetable fibrous material in an oil varnish, draining the varnished material in the open air, and exposing the coated product to ozonized air at an elevated
10 temperature.

5 5. The process of increasing the tensile strength of vegetable fibrous material which comprises placing the fibrous material in an oven, exposing the fibrous material to ozonized air, and regulating the heat of the oven
15 so that the fibrous material and ozonized air will have a temperature between 75° and 110° centigrade.

20 6. The process of increasing the tensile strength of vegetable fibrous material which comprises placing the fibrous material in an oven, exposing the fibrous material to ozonized air for a period of not more than eight hours and regulating the heat of the oven so
25 that the fibrous material and ozonized air will have a temperature of not above 120° centigrade.

30 7. The process of increasing the tensile strength of varnished vegetable fibrous material which comprises placing the said material in an oven, exposing the same to ozonized air for a period of not more than thirty-two hours and regulating the heat of the oven so that the ozonized air will have a temperature
35 of not above 130° centigrade.

8. The process of increasing the tensile

strength of vegetable fibrous material which comprises exposing it to ozonized air for a period of about thirty minutes at a temperature of not above 150° C., the percentage of
40 ozone in the air being about 0.1 per cent.

9. The process of increasing the tensile strength of vegetable fibrous material which comprises exposing it to ozonized air for a
45 period of about thirty minutes at a temperature of 110° C., the percentage of ozone in the air being not more than 0.5.

10. Vegetable fibrous material which has been exposed to ozonized air at an elevated temperature and being characterized by having a greater tensile strength than untreated
50 fibrous material of the same character.

11. A vegetable fibrous product resulting from the reaction of vegetable fibers and ozonized air at an elevated temperature. 55

12. A vegetable fibrous product resulting from the reaction of vegetable fibers and ozonized air at an elevated temperature and having 20 to 30 per cent greater tensile
60 strength than the untreated vegetable fibers.

13. A varnished vegetable fibrous product resulting from the reaction of varnished vegetable fibrous material and ozonized air.

14. The process of increasing the tensile strength of vegetable fibrous material which
65 comprises exposing the said material to ozonized air at a temperature between 75° and 150° centigrade.

In testimony whereof, I have hereunto subscribed my name this 12th day of July, 1927.

PAUL B. COCHRAN.