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# PROCESS FOR CURING TOBACCO

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## ABSTRACT OF THE DISCLOSURE

A process for curing tobacco which comprises freezing moisture containing tobacco leaves and stems, permitting any frozen water present in said frozen tobacco leaves or stems to thaw and removing the thawed alkaloid-containing water from said tobacco leaves or stems. Generally, it is preferable to freeze the tobacco leaves or stems as soon as possible after picking, and it is also preferred to remove the thawed water from the frozen tobacco leaves or stems as soon as possible. Tobacco cured by the novel process of the invention has a lowered alkaloid and sugar content, will not absorb substantial amounts of atmospheric moisture, and does not sponge or rot upon storage. In addition, no re-drying is required before commercial usage.

## BACKGROUND OF THE INVENTION

### Field of the invention

The invention relates to a process for the curing of tobacco.

### Description of the prior art

In the prior art, flue curing is the most commonly accepted method of curing tobacco. Generally, tobacco may be flue-cured only when it is fully mature. This necessitates a number of separate "pickings" of the tobacco plant. It is common practice to start and remove the bottom leaves (generally 1–5) from the tobacco plant. These leaves are known as the "lugs." Approximately one week later the next higher 1–5 leaves are removed from the stalk. Generally, the leaves which are located in the middle of the tobacco stalk are known as "leaf" tobacco. The leaves which occur at the top of the tobacco plant are known as the "tips."

It is generally accepted in the tobacco industry that tobacco taken from the lower stalk positions has a relatively high filling capacity and generally has a lower nicotine content than "tip" tobacco.

The process of picking tobacco in progressive steps up the stalk generally requires from 4 to 8 separate pickings for flue-cured tobacco. This is due to the fact that if tobacco is picked for flue-curing before it is ripe, it will "grain" or turn black. This is an undesirable quality in tobaccos since the aromas produced thereby are unacceptable. On the other hand, if the tobacco is allowed to become over-ripe, this tobacco will generally be higher in nicotine content than ripe tobacco, will be excessively chaffy and will lose its natural color. Thus, it can be seen that utilizing present day curing methods (flue-curing) it is critical that the tobacco farmer harvest the tobacco at the exact stage of acceptable ripeness. If the tobacco is picked too soon or too late, the farmer will suffer economic loss as the tobacco will be commercial unacceptable.

Since the pickings generally take place about a week apart, it can be seen that as much as two months may be required to gain the full productivity of a single stalk of tobacco. In opposition to this, applicants' novel process enables immature tobacco to be utilized. By the



term immature, it is to be understood to mean that this enables the leaves to be picked in a green state, as opposed to the mature state required in the flue-curing process.

Thus, it can be seen that by utilizing applicants' novel process which enables the picking of immature tobacco, which is typified as acceptable in the green state, the number of picking steps can be decreased at least by one half, thereby giving the average farmer the opportunity to pick his tobacco and cure it without the risks existent with the present flue-curing method.

Of course, it will be appreciated that mature tobacco can be utilized in applicants' novel curing process, but applicants' process is not restricted to mature tobacco as is flue-curing.

Generally, in flue-curing after the tobacco is taken from the stalk it must be transported to a "cure barn." It is there supported and placed under conditions of heat. Usually, forced air is utilized and a gradual increase in temperature is required until the stem of the tobacco leaf is killed. The tobacco cannot be heated rapidly because this will cause the tobacco to discolor thereby ruining the quality of the tobacco for commercial sale. Sudden advances in temperature will cause the condition known in the tobacco industry as "green scald." In addition, when tobacco has been cured to a temperature above that generally acceptable (170° F.) a red color may be exhibited in the cured leaf. This is generally commercially unacceptable.

Proper curing basically involves removing water from the tobacco and still maintaining its commercial acceptability. When the water from the tobacco is not properly removed, the tobacco may "sweat" and often "brown scald" and "sponge" may result. "Brown scald" occurs when the tobacco dries too slowly (sweats) under conditions of temperature and humidity which are too high for the condition of the tobacco. "Sponge" is caused by maintaining humidity which is too high or else utilizing a temperature which is too low for the condition of the tobacco. "Sweating" commonly occurs when the tobacco is not properly spaced, ventilation is insufficient, or when the moisture in the leaf is too high.

Thus, it can be seen that utilizing present day curing conditions (flue-curing) a large number of highly critical factors exist which can easily render the entire tobacco crop of a farmer unacceptable. It is critical that the curing schedule of the tobacco be adopted to the degree of ripeness of the tobacco and the conditions under which the tobacco is grown, harvested and cured.

Generally, in flue-curing, the heating is started at from 98 to 100° F., and is increased to a maximum temperature of 180° F. Higher temperatures are inadvisable. The majority of farmers today probably utilize 170° F. as the maximum acceptable temperature. Of course, the lower the final temperature realized, the longer the flue-curing process takes.

The tobacco will normally remain in the curing barn from 72–78 hours for each picking.

The tobacco must then be permitted to cool and absorb natural moisture. This is required in the fluecuring process to enable the tobacco to become flexible enough for handling.

Once the tobacco has absorbed sufficient moisture to become flexible, it may be separated, graded as to quality and taken for sale. At this point, the manufacturer must re-dry the tobacco which has been flue-cured or it will mold and rot.

As stated, whereas flue-cured tobacco may require from 4 to 8 pickings, applicants' novel process enables the total leaves from a tobacco stalk to be obtained in from 1 to 3 pickings if desired. The amount of time required to cure tobacco leaves and/or stems under applicants'

novel process is merely that time required to completely freeze the tobacco, thaw it and dry it. In addition, applicants' curing process does not require any cooling time before the cured tobacco may be removed. The cooling time required in flue-curing is generally from 5 to 8 hours, depending on the natural or artificial humidity utilized.

Thus, it can be seen that applicants' novel curing process enables the tobacco farmer to realize a substantial savings in labor costs since the number of pickings is less, cuts down curing time to a small fraction of that formerly required, and completely eliminates the after-cure cooling step which is necessary with flue-cured tobacco.

Other types of curing are known, such as that utilized for curing Burley (Maryland) tobacco. Generally, to form chewing tobacco this is an air curing step in the shade. Several days to several weeks may be required. The nicotine content in Burley tobacco is generally several times greater than that in flue-cured tobacco. Quite often, Burley tobacco is de-nicotinized due to the high nicotine content. Generally, de-nicotinizing is not useful on flue-cured tobacco because of its high sugar content. Burley tobacco has essentially no sugars present therein because they are oxidized during the air-curing process.

## SUMMARY

Applicants' novel curing process involves freezing, thawing and drying tobacco leaves or stems. Although the remainder of the application is directed toward the leaf of the tobacco plant, it is to be understood that the basic principles also apply to the stem of the plant. The freezing is conducted so as to rupture the fibers of the tobacco leaf thereby permitting any water present to be released from the fibers. This released water may also contain dissolved substances which may be removed with the water. It will be apparent that some unsoluble material may also, at times, be "carried out" with the water during removal. The novel process of applicants' invention enables the average farmer to realize a tremendous savings in labor costs, cuts down the total amount of time required for curing by standard methods, and enables the farmer to easily handle and transport cured tobacco without the present dangers of spoilage and rot which are encountered. The savings in total labor time is appreciated when it is realized that it takes in the area of 218 hours of labor to hand-harvest one acre of tobacco. Of this time, approximately 70% of the 218 hours is required to hand and string the tobacco, hang it in the curing barn and take it out. It can immediately be seen that applicants' novel process enables a large proportion of this time to be totally eliminated, thereby allowing the tobacco farmer to realize a substantial savings. The tobacco will, in fact, keep indefinitely. It is very porous and does not require re-drying before storage. Applicants have found that the tobacco burns slower, and gives a milder subjective taste to the user. In addition, testing has indicated that the alkaloid and sugar content of tobacco cured by applicants' novel process is reduced.

## DISCLOSURE OF THE PREFERRED EMBODIMENTS

Generally, the tobacco which is utilized in applicants' novel process may be picked in the green state, and it is not necessary to wait for ripening and maturity of the tobacco as required under presently utilized systems. Thus, applicants may pick the tobacco from the stalk in one picking, or may utilize any greater number of pickings. The number of pickings is not critical, but it must be realized that as the number of pickings decreases, a substantial reduction in labor costs may be realized to the farmer. It will be apparent that as the number of pickings is decreased, the number of curings will also be decreased, thereby enabling the farmer to realize a substantial decrease in curing costs.



Utilizing the present methods, when tobacco is ripe it must be picked within 1–4 days, or it will dry on the stalk or burn. Decay soon follows burning of tobacco.

Once the tobacco is picked, it is preferable that the tobacco be frozen as soon as possible. While applicants do not wish to be bound by the following theory, it is believed that the higher the moisture content in the tobacco when it is frozen, the greater will be the degree of alkaloid removal and porosity. In addition, it is belived that once tobacco is picked from the stalk and maintained at ambient or heated conditions, the formation of alkaloids results. In this respect, it is theorized that by freezing the tobacco as soon as possible after picking, that any chemical reactions which occur at ambient temperatures or above are markedly reduced by the freezing of applicants' novel process. It can be seen that any chemical reactions which may occur in the tobacco after picking will actually be increased by flue-curing which involves elevated temperatures, and will, at best, proceed at a substantial rate when curing is conducted in the open air at ambient conditions.

Generally, applicants have found that the tobacco must be subjected to the freezing process within 6–8 hours after picking. Preferably, this is done as soon as possible after the tobacco is picked.

Applicants have found that the minimum water content of the tobacco when it is picked from the stalk which is acceptable is from 80—85% by weight. However, the greater the moisture content, the more acceptable the final product. In this respect the most preferred moisture content range is from 90 to 98% by weight.

As stated, any freezing process may be utilized. Of course, it is necessary that the water be completely frozen in the tobacco plant to obtain optimum results. It is theorized that this is due to the fact that the greater the degree of freezing the greater the degree of rupturing which can be obtained in the tobacco leaf upon the expansion of water. Thus, under ordinary conditions, any temperature below 32° F. will suffice.

Applicants have found that once the process of temperature lowering has started that there does not appear to be any great degree of criticality on the rapidity of the freezing process. However, under the proposed theory which applicants have developed, it will be apparent that the more rapid the freezing the sooner any chemical reactions will be halted in the interior of the tobacco leaf. Generally, optimum results are obtained if the tobacco is frozen within four hours from the beginning of the freezing process, although periods as long as twelve hours may be acceptable in some cases. Of course, it is always necessary that the maximum rupturing of the tobacco fibers be obtained to realize the optimum results.

After the maximum degree of freezing, and thereby rupturing of the tobacco fibers, is obtained, it is necessary to thaw the frozen tobacco leaf.

Since it is not possible to completely stop any chemical reactions occurring in the tobacco leaves even by reduction to temperatures below 32° F., it is preferred that the thawing of the tobacco leaf take place as soon as possible after complete freezing is realized although this is not critical.

As will be apparent from applicants' theory, once the ice which has been formed to rupture the tobacco fibers is permitted to thaw, any chemical reactions which have been slowed down or halted will start again. Therefore, to realize the maximum benefits from applicants' invention it is necessary to thaw the frozen tobacco leaf as quickly as possible. In this respect, either artificial or natural means can be utilized. The time involved will, of course, depend on the desired alkaloid and sugar content of the final product. It will be within the scope of one skilled in the art to select proper thawing times in view of the fact that the more rapid the thawing, the lower the alkaloid content. However, if the alkaloid content of the tobacco is of no importance, it must be realized

that the only other criticality involved in the thawing step is that it will be, in certain instances, desirable to mechanically remove any water present in the tobacco leaf. This may be accomplished by a pressing step or the equivalent. It will be apparent that the longer the tobacco is permitted to thaw, the greater will be the chance of moisture removal by natural means. Therefore, there will be less moisture present which will be removed by pressing, and consequently a somewhat lessened removal of foreign materials which may be carried by moisture present.

As stated, after the tobacco has been completely thawed, it is necessary to dry the tobacco. Drying may, generally, be by any method desired. Applicants have found that both natural and artificial methods utilizing air are acceptable. Of course, it will be obvious to one skilled in the art that various types of radiation-aided drying may be utilized. Often, it may be preferred to press or squeeze the tobacco to remove the water. Although applicants do not wish to be bound by this theory, it is believed that if the tobacco is compacted or squeezed to remove the moisture, then a greater amount of alkaloids and other foreign materials will be carried out of the tobacco with the moisture which is forced from the tobacco leaf. It would appear that pressing, or a similar process, would enable greater amounts of moisture to be removed more rapidly than by air drying or the like.

It will be appreciated that by pressing the water from the thawed tobacco leaf, foreign materials present may be carried out with the water which is forced from the leaf. This would appear beneficial where removal of these constituents is desired. However, if it is preferred to leave some of the foreign materials in the tobacco leaf, it may be more desirable to utilize an evaporation drying or similar process.

It will be apparent that under applicants' proposed theory, the quicker the drying is carried out, the lower the alkaloid content. Generally, it is preferred that the drying be conducted during a period less than 8 hours following complete thawing.

There are several variables in the above described process which may be adjusted. For instance, once the tobacco has been completely frozen and maximum rupturing of the tobacco fibers has been obtained, the criticality of removing the tobacco from the freezer as soon as possible is lessened. This is due to the fact that at the lower temperatures involved in the freezing process, chemical reactions appear to be reduced to such a substantial extent that no harmful degradation can occur. It must be appreciated, however, that at any stage prior to the completion of the process it is preferred to maintain the tobacco at temperatures above freezing for as short a time as possible. The reasons for this are apparent in view of the above discussion.

Specific Example 1

Hick's tobacco was picked from the applicants' field and was placed in a freezing apparatus as soon as possible. This was within 8 hours of the time of picking. The tobacco leaves were frozen by leaving them overnight in the freezing apparatus. The time involved was approximately 8–10 hours. Each leaf was then allowed to thaw out under normal conditions, and the water was pressed from the ruptured leaf. The water freely came out of the leaf during the pressing process.

The tobacco was rolled into cigarettes, and subjectively tested by applicants. The product had a somewhat milder taste than tobacco which had been simultaneously flue-cured from the same field, and yet taste and aroma seemed to remain in the product.

The tobacco cured by applicants' novel process was stored, and no deterioration in the product was noted.

Specific Example 2

In this example, the top leaves or tips of the tobacco plant were picked. It is generally known in the tobacco industry that the top leaves of the tobacco plant carry the highest content of alkaloids.

The tobacco was taken to the freezing apparatus as soon as possible, and completely frozen. From observation of the tobacco, it appeared that complete freezing occurred between 1 and 2 hours. The tobacco was permitted to thaw and the water was immediately pressed out with the same result as in Example 1.

Specific Example 3

In Example 3, the same procedure is used as in Example 2. The top or the tip tobacco leaves from the 1967 crop were picked to be frozen. The tobacco variety was Coker 319. It was found that by utilizing a proper spacing of the leaves, a quicker freeze could be obtained. Obviously, proper spacing of the leaves relates to the storage capacity of the freezing apparatus, and will be within the scope of one skilled in the art to determine for the individual capacity under consideration. During this freezing, it was found that there was no significant difference between the tobacco left in the freezer for a period of time after freezing had been accomplished and that tobacco which was immediately thawed and dried. The only criticality is that the maximum rupture of the tobacco leaf desired must be obtained.

After thawing and drying as formerly described, tobacco cured utilizing the novel process of applicants' invention was compared to flue-cured tobacco. It was found that the flue-cured tobacco reabsorbed water and the amount of this water varied as the relative humidity of the ambient air varied.

In opposition to the tendency of the flue-cured tobacco to reabsorb water, tobacco cured by applicants' process remained in the dry stage. For instance, it was found that the water content of the flue-cured tobacco as it was picked up for handling was in the general range of 12–14% by weight. The water content of the tobacco cured by applicants' novel invention ranged approximately from 5–8% by weight. Thus, it can be seen that applicants' invention also enables the farmer to realize some advantage in shipping costs, since the weight of the tobacco is less as compared to flue-cured tobacco.

Further, the tobacco cured by applicants' process illustrated in Example 3 was subjected to chemical analysis utilizing standard testing techniques. Upon analysis, the total alkaloid content of the tobacco was 1.4% and the soluble sugar content was approximately 9.47%. From the tobacco crop in 1967 (from which this sample was selected), these constituents are lower than normally expected especially for up-stalk tobacco. Generally, for this type of tobacco the nicotine content is approximately 2.36%, and the sugar percentage is approximately 26.25%. Thus, it can be seen that applicants' novel process enables both the nicotine and sugar content of the tobacco to be substantially decreased. The total alkaloid content, which is largely nicotine, was less than half normally experienced upon standard chemical analysis of flue-cured tobacco. This testing was performed by The Agricultural Extension Service of The North Carolina State University.

In the above examples, various drying methods were utilized. Utilizing natural air, it was found that from 8–10 hours were generally required to dry the tobacco. If a forced air stream was utilized, generally from 2–6 hours were required. A combination of forced air and heat required from 1–3 hours. Of course, if the leaves were pressed, drying was accomplished almost instantly. It will be appreciated by one skilled in the art that the drying time naturally varies with the size of the leaf stems. In addition, it will be within the skill of one versed in the art to vary the rate of air flow and the temperature of the air to realize the most optimum conditions for the leaf stems under consideration.

One skilled in the art can appreciate the various types of tobacco to which applicants' novel process may apply.

Generally, it is only necessary that the tobacco exhibits a sufficient moisture content and be susceptible to fiber rupturing upon freezing. It will be obvious from the specification that tobacco which is capable of being flue-cured meets these conditions. Since Burley tobacco has a very high nicotine content, Burley tobacco should exhibit a significant lowering in the nicotine percentage upon treatment by applicants' novel process. Representative of the various types of tobacco which may be cured utilizing applicants' novel process are: Hick's broadleaf, NC 95, Bell 29 and 93, Coker 254, 258 and 319, McNair 14, NC 2326, Speight G–7, G–13 and G–36, S.C. 66 and Va. 115. The tobaccos listed above generally have a minimum nicotine content of 2.34%, a maximum nicotine content of 2.96% and minimum and maximum sugar contents of 26.25% and 29.25%, respectively.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

**1.** A process for curing tobacco leaves which comprises:

freezing said tobacco leaves,

thawing said frozen tobacco leaves, and

drying said thawed tobacco leaves.

**2.** A process as in claim **1** wherein said tobacco is frozen within 4 to 8 hours from the time of picking.



**3.** A process as in claim **1** wherein the moisture content of said tobacco leaves is at least 80% before freezing.

**4.** A process as in claim **1** wherein said drying step is initiated immediately after the tobacco is completely thawed.

**5.** A process as in claim **1** wherein said tobacco is dried by pressing.

**6.** A process as in claim **1** wherein said freezing is conducted until the fibers of the tobacco are completely ruptured.

**7.** A process as in claim **1** wherein said tobacco is dried by permitting said thawed moisture to evaporate.

**8.** A process as in claim **1** wherein said drying is accomplished within about 8 hours from the completion of said thawing step.

**9.** Tobacco cured by the process of claim **1.**

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