

Improvements relating to the removal of Soluble Components from Tobacco Material and Apparatus therefore.

The present invention relates to a process for removal of soluble
5 components from tobacco material, and apparatus therefor.

Due to the existence of chemical differences between tobacco
grades and types, for example Virginia and Burley tobaccos, compositions, or
blends, of several grades or types are required in order to obtain a final tobacco
blend with chemically and sensorially balanced compositions for use in smoking
10 articles, cigarettes for example.

Certain grades or types of tobacco contain certain substances in
amounts exceeding desired levels, thus making it necessary to dilute the tobacco
before use in a smoking article. Some sensory attributes are natural for, and
specific to, certain tobacco types so making their use indispensable in some
15 instances. Dilution of tobacco types may reduce applicability or render the use of
certain tobacco types and/or grades of tobacco inflexible. It has heretofore been
proposed to remove various components from tobacco material to leave a product
with altered chemical and physical characteristics. Products with altered physical
characteristics generally require a further processing step in order that they be
20 utilisable in a smoking article, as a reconstituted tobacco product for example.

In order to overcome the often costly need for further processing of
physically altered tobacco material, various processes have been described in
which chemical alteration of tobacco material is affected without significantly
altering the physical characteristics thereof.

25 In US 5,360,022 it was proposed that water soluble components be
removed from tobacco material in a single step process using a liquid solvent. The

process utilised a single extraction housing, set at an incline to the horizontal, in which solvent and tobacco material flow counter-currently within the housing. The extraction process required the tobacco material to be lifted out of the solvent during rotation of a conveying screw located within the housing, the conveying
5 screw being operable in both the forward and reverse directions. Extraction of components from the tobacco material is facilitated by operation of the conveying screw in the forward and reverse directions alternately whilst feeding tobacco into the upstream end of the extraction housing and solvent into the downstream end of the extraction housing. As would be apparent to those skilled in the art, lifting
10 of the tobacco material out of the solvent by each rotation of the conveying screw would protract the total time taken to facilitate extraction of the necessary components from the tobacco material. A protracted extraction time is both costly and time consuming and may ultimately affect the physical characteristics of the tobacco material by prolonged exposure to the solvent.

15 US 5,791,353 discloses a method of denitrifying tobacco stem material utilising a pressure-tight apparatus in which the single extraction housing is set at an incline to the horizontal and comprises a conveying screw that lifts tobacco material out of the solvent through each rotation thereof. An overpressure within the system reduces the extraction time, however necessitates
20 the use of a pressure-tight system, therefore, the operational costs of the system are considerable.

The present invention is predicated upon Applicant's realisation that it is important when extracting components from tobacco material that the residence time of the tobacco material in a solvent is minimised such that the
25 physical characteristics of the tobacco material remain substantially unaltered by the extraction process and that the required extraction efficiency of the process

should utilise the minimum solvent volume possible.

As referred to herein, required extraction efficiency shall be taken as meaning the proportion of a soluble component needed to be removed from the tobacco material in order to obtain a tobacco product with the necessary
5 chemical composition.

It is an object of the present invention to provide for the efficient and commercially practical removal of soluble components from tobacco material.

It is a further object of the present invention to provide a process,
10 and apparatus, for the removal of soluble components from tobacco material whereby the environmental impact of the process is minimised by maximising the efficiency of solvent use during the process.

It is an even further object of the present invention to provide a process for removal of soluble components from tobacco material whereby there is produced
15 a chemically altered tobacco material, said material having greater flexibility in terms of its uses in blended tobacco products, whilst the physical characteristics of the tobacco material remain substantially unaltered by the process.

The present invention provides a multi-stage process for removal of soluble components from tobacco material, wherein tobacco material is
20 sequentially substantially submerged in a solvent within a series of inclined extraction tanks.

Preferably the tobacco material is sequentially substantially submerged in three extraction tanks.

Preferably each stage of the multi-stage process inputs tobacco
25 material into a further extraction tank, each of which extraction tanks is substantially filled with solvent.

The tobacco material is preferably conveyed through each extraction tank from the upstream to the downstream end thereof, whilst being substantially submerged in the solvent. The tobacco material is then output from each extraction tank and subsequently input into a further extraction tank or removed from the extraction apparatus.

As stated above, tobacco material is sequentially substantially submerged in a solvent within a series of inclined extraction tanks, the passage of tobacco material through the series of extraction tanks being in a given direction, i.e. from an upstream end to a downstream end of each tank. It is much by preference that solvent is sequentially supplied to the series of the extraction tanks in a direction opposite to that of the flow of tobacco material. Therefore, within the series of extraction tanks the tobacco material supply and solvent supply flow counter-currently.

Advantageously, within each extraction tank, solvent and tobacco material flow in the same direction. Most advantageously solvent and tobacco material, within each extraction tank, flow from the upstream to the downstream end of that tank.

Suitably, conveyance of the tobacco material through the extraction tank is enhanced by the action of a solvent recycling pump. The solvent recycling pump is operable to remove solvent from the downstream end of the extraction tank via a recycling pipe, and to pump solvent into the upstream end of the same extraction tank. The suction afforded by the solvent recycling pump draws the tobacco material through the extraction tank towards the downstream end thereof.

Preferably the tobacco material to be extracted according to the process of the present invention is continuously fed into a first extraction tank

before undergoing sequential extraction in the first, second and third (if present) extraction tanks. Preferably, solvent is continuously fed into the third extraction tank and is sequentially fed from the third extraction tank to the second and then the first extraction tank. It will be apparent to those skilled in the art that more than three extraction tanks may be used in the process of the present invention though two extraction tanks may be sufficient.

Preferably the residence time of the tobacco material in each extraction tank is between about 5 minutes and about 15 minutes, more preferably is between about 5 minutes and about 10 minutes and even more preferably is about 5 minutes. It will be clear to those skilled in the art that the residence time for the tobacco material in each extraction tank will be dependent on the tobacco material undergoing extraction, and the solvent used to extract the soluble components from said material. The residence time for the tobacco material in each tank will further depend upon the required extraction efficiency for the tobacco material.

Preferably the solvent temperature in each extraction tank will be in the range of about 70°C to about 95°C and even more preferably between about 80°C and about 85°C. Heat exchangers may be provided between extraction tanks to maintain the solvent temperature. Heat exchangers may also be provided in the solvent recycling pipe of each extraction tank, thus maintaining solvent temperature within each extraction tank.

Solvents suitable for use in the process of the present invention may be selected from the group comprising water or alcohol: water mixtures. Other suitable solvents will be known to a person skilled in the art.

The ratio of total mass flow rate of tobacco material to total mass flow rate of solvent in the series of extraction tanks may suitably be between about 1:2

and about 1:30 and is preferably between about 1:4 and about 1:20 and is even more preferably between about 1:4 and about 1:10. That is to say, for example, for every 1 unit weight tobacco material entering tank 1, 10 units weight solvent enters the final tank in the series of tanks used in the process. The ratio of total mass flow rate of tobacco to total mass flow rate of solvent will be dependent on the chemical characteristics required in the tobacco product resulting from the extraction process, i.e. the required extraction efficiency of the process.

Tobacco material suitable for the process of the present invention may suitably be cut lamina, stem, dust or fines.

Advantageously, when the tobacco material is stem, the stem has a particle size of between about 7/8 inches (22mm) and about 2 inches (51mm).

The process of the present invention is particularly useful for removal of nitrites, nitrates and Tobacco Specific Nitrosamines (TSNAs) from tobacco material.

The present invention further provides extraction apparatus comprising a plurality of inclined extraction tanks, each extraction tank comprising an extraction housing, conveying means, tobacco material inlet and outlet means, and solvent inlet and outlet means.

Advantageously the extraction apparatus comprises three extraction tanks.

According to the present invention the extraction tanks are advantageously inclined at a negative angle to the horizontal. As referred to herein, a negative angle to the horizontal shall be taken as meaning that the upstream end of the extraction tank is higher, relative to the ground, than the downstream end thereof, thus the extraction tank is set on a decline from its upstream end to its downstream end.

Preferably the extraction tank is inclined at a negative angle to the horizontal of up to about 5°, and is more preferably at a negative angle of between about 3° and about 4° to the horizontal.

Advantageously the extraction housing is a hollow, substantially
5 cylindrical tube.

Preferably the conveying means is a screw conveyor. Alternatively the conveying means may be a conveying belt comprising tobacco material retaining means, pins for example. Other suitable conveying means will be known to those skilled in the art. Preferably the conveying means is disposed
10 within the extraction housing.

Advantageously the screw conveyor comprises fins. Preferably the fins are positioned so as to form a helicoid flight on the screw conveyor.

Preferably the screw conveyor is axially aligned with the longitudinal axis of the extraction housing. More preferably the screw conveyor
15 is co-axially aligned with the longitudinal axis of the extraction housing.

Preferably the screw conveyor is rotatably mounted to the extraction housing and is rotatable by motor means operably attached thereto. Suitably the rotational speed of the screw conveyor is selected in accordance with the desired residence time of the tobacco material in the extraction tank.

Alternative conveying means may be in other than axial alignment with the extraction housing. The alternative conveying means, for example, may be set at angle to the longitudinal axis of the extraction housing. When the conveying means is set at an angle to the longitudinal axis of the extraction housing, fins attached to the conveying means are configured so as to rotate
20 within the extraction housing without obstruction.
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The tobacco inlet means of each extraction tank is preferably a hopper or, alternatively, a conveyor belt, which, together with an opening in the extraction housing, allows tobacco material to enter the extraction housing at the upstream end thereof.

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Each extraction tank comprises tobacco outlet means at the downstream end thereof. Preferably the tobacco outlet means comprises dewatering means, by which means tobacco material may be removed from the extraction tank through an opening therein.

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Advantageously the dewatering means is a dewatering screw. Preferably the dewatering screw extends into a dewatering means solvent tank, which dewatering means solvent tank forms an integral part of the extraction housing at the downstream end thereof.

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Preferably the dewatering screw comprises a hollow, helicoid screw (as illustrated in the brochure of WAMGROUP) operable to remove tobacco from the extraction tank. Most preferably the dewatering screw has a hollow, corkscrew configuration. Suitably the dewatering screw is rotatable by drive means.

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Advantageously the dewatering screw is set at a positive angle to the horizontal such that, in operation, excess solvent flows back into the extraction tank whilst tobacco material is removed from the tank.

Preferably the dewatering means may further comprise a press at an end thereof, which end is distant from the extraction housing, the press being operable to remove excess solvent from the tobacco material. Preferably one or

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more of the extraction tanks comprises dewatering means with a press at an end thereof. It is much by preference that at least the final extraction tank comprises dewatering means with a press at an end thereof.

5 Preferably each extraction tank is provided with solvent recycling means. Suitably the solvent recycling means is a pump operable to remove solvent from the downstream end of the extraction tank via a recycling pipe, and to input solvent into the upstream end of the same extraction tank.

10 Each extraction tank comprises solvent outlet means, which means are preferably located such that solvent exits the extraction housing from the dewatering screw solvent tank. Even more preferably the solvent outlet means exits the extraction housing from an upper portion of the dewatering screw solvent tank.

15 Advantageously the solvent outlet means of one extraction tank is joined to the solvent inlet means of the preceding tank via a solvent pipe.

Advantageously solvent originates from a solvent reservoir, the solvent reservoir containing solvent with no components dissolved therein.

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Advantageously the solvent outlet means has pump means operably attached thereto.

Preferably the solvent outlet means of the first extraction tank is
25 linked to waste solvent treatment means via a solvent pipe.

It is much by preference that heat exchangers are provided between extraction tanks and between the solvent reservoir and the solvent inlet means of the final extraction tank. The heat exchangers are operable to maintain the solvent temperature within the series of extraction tanks.

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Advantageously, heat exchangers may be provided in the solvent recycling pipe of each extraction tank, thus maintaining solvent temperature within each extraction tank.

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It will be understood from the foregoing description that within each extraction tank, tobacco material and solvent flow in the same direction from the upstream end of the extraction tank to the downstream end thereof. Furthermore, in the process of the present invention, it will be understood that the general overall flow of tobacco material through the series of extraction tanks is in the forward direction from the first extraction tank onwards, whereas the general overall flow of solvent through the series of extraction tanks is in the reverse direction, i.e. from the last extraction tank to the penultimate extraction tank and onwards to the first extraction tank. From the first extraction tank, solvent may be conveyed to a waste treatment process where soluble components may be removed therefrom and, if required solvent is recycled for re-use in the extraction process.

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Within each extraction tank a partial equilibrium is allowed to form between the components in the tobacco material and the components thereof dissolved in the solvent within that tank. The residence time of the tobacco material in each extraction tank, the solvent temperature and the ratio of the total

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mass flow rate of tobacco material to the total mass flow rate of solvent in the series of extraction tanks will affect the partial equilibrium and, therefore, the extraction efficiency of the process. The parameters of the process may be set to produce a tobacco product having the required chemical characteristics after
5 extraction.

The creation of a solvent extract concentration gradient within the series of extraction tanks facilitates the efficient use of solvent to produce the required extraction efficiency for the process. The solvent extract concentration
10 is greatest in the first extraction tank and lowest in the last extraction tank.

In order that the present invention may be clearly understood and readily carried into effect, reference will now be made, by way of example, to the following examples and accompanying drawings, in which:
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Figure 1 shows an extraction tank of the present invention in longitudinal cross-section, and

Figure 2 shows a multi-stage extraction apparatus according to one
20 embodiment of the present invention.

Features common to both Figure 1 and Figure 2 are denoted by the same reference numerals in both Figures.

Figure 1 relates to extraction apparatus for use in a single step of
25 the process of the present invention. Each step of the process utilises a single

extraction tank, generally denoted by the reference numeral 24. The extraction tank comprises an extraction housing 3, the extraction housing 3 being a hollow, substantially cylindrical tube. A conveying means 4 is disposed within extraction housing 3. In this embodiment the conveying means is a screw conveyor 4.

The screw conveyor 4 is coaxially aligned with the longitudinal axis of the extraction housing 3 and is located within the extraction housing 3 such that the conveyor 4 does not extend into the downstream end of the extraction housing 3. The screw conveyor 4 is rotatable by drive means (not shown), a motor for example. The speed of rotation of the screw conveyor 4 is altered to effect a change in the residence time of tobacco material within the extraction housing 3. The screw conveyor 4 further comprises fins 5, which fins 5 are positioned so as to form a helicoid flight on the screw conveyor 4.

The extraction tank further comprises tobacco inlet and tobacco outlet means (2,25). The tobacco inlet means 2 is a hopper (not shown) located at the upstream end of extraction housing 3.

The tobacco outlet means 25 is positioned at the downstream end of the extraction housing 3. Figure 1 shows one embodiment of the invention in which the tobacco outlet means 25 is a dewatering screw.

The dewatering screw extends into the extraction housing 3, through an opening therein, into a dewatering screw solvent tank 11, the tank 11 forming an integral part of the extraction housing 3 at the downstream end

thereof.

The dewatering screw comprises a dewatering screw housing 13 and a helicoid screw flight 14. The helicoid screw flight 14 of the dewatering screw is of a corkscrew configuration which has a central bore (not shown) disposed down the longitudinal axis thereof. The dewatering screw is rotatable by drive means (not shown), a motor for example.

In operation the dewatering screw rotates and lifts the tobacco material from the extraction housing 3, through an opening therein, whilst excess solvent drains through the central bore of the dewatering screw into the dewatering screw solvent tank 11. The dewatering screw is configured in such a way as to allow solvent to drain into the central bore at any point along the length of the screw.

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The dewatering screw has a press 15 located at an end thereof, which end is distant from the extraction housing 3. The press 15 is operable to remove excess solvent from the tobacco material before the material is output from a first extraction tank 24, through tobacco outlet 16, and is input into a further extraction tank 24 or, alternatively, is output from the extraction apparatus.

The extraction tank 24 has solvent inlet and outlet means (1,12). The solvent inlet means 1 is a pipe which enters the extraction housing 3 at the upstream end thereof. The solvent outlet means 12 is a pipe which allows solvent to exit the extraction housing 3 at the downstream end thereof. The

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solvent outlet means 12 is located such that solvent exits the extraction housing 3 from the upper portion of dewatering screw solvent tank 11. The solvent outlet means has a solvent pump 18 operably attached thereto.

5 The extraction tank 24 may further comprise a solvent temperature sensor 17 and/or a solvent level sensor 10.

Figure 1 also shows a solvent recycling system integral with extraction housing 3. A recycle pump 8 is operable to remove solvent, via a
10 recycle pipe line 7, from the downstream end of extraction housing 3 and to return the solvent to the extraction housing 3 at the upstream end thereof via solvent recycle inlet 6. A heat exchanger 9 is integral with recycle pipe line 7. Solvent is passed through heat exchanger 9 before being returned to extraction housing 3.

15 Figure 2 shows a complete apparatus according to one embodiment of the present invention. The apparatus comprises three extraction tanks 24, each extraction tank 24 being shown in Figure 1. The extraction tanks 24 form a modular system and a person skilled in the art will understand from the
20 foregoing description that alternative embodiments of the present invention may comprise two or more extraction tanks.

According to the embodiment shown in Figure 2, a first extraction tank 24 has a solvent inlet 1 which is linked by means of a solvent pipe 19 to the
25 solvent outlet 12 of the second extraction tank 24. The second extraction tank 24 has a solvent inlet 1 which is linked by means of a solvent pipe 21 to the solvent

outlet 12 of the third extraction tank. The third extraction tank 24 has a solvent inlet 23 which is linked to a clean solvent reservoir (not shown). The solvent outlet 12 of the first extraction tank 24 is linked to a waste solvent treatment system (not shown). Optionally, heat exchangers 20,22 are provided between the first and second extraction tanks 24, and between the second and third extraction tanks 24, respectively.

In operation, the extraction apparatus is supplied with solvent from an external solvent reservoir (not shown). The solvent is pumped into the third extraction tank 24, via solvent inlet 23, and each of the extraction tanks 24 is filled with solvent until the solvent level sensors 10 in each extraction tank 24 indicate that solvent input should cease. The solvent temperature sensors 17 in each tank monitor the solvent temperature and the heat exchangers 20 and 22 ensure that the solvent is maintained at the correct temperature for extraction.

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The solvent substantially fills the extraction tanks such that a major portion of the conveying means is submerged in solvent.

Each extraction tank 24 is inclined at a negative angle to the horizontal, ensuring that approximately one quarter of the screw conveyor is free of solvent at the upstream end thereof.

During the extraction process, the solvent is continuously fed to the extraction apparatus from the clean solvent reservoir (not shown), via a heat exchanger (not shown), into the solvent inlet 23 of the third extraction tank 24. Solvent from the third extraction tank 24 is output therefrom via solvent outlet

12 and is pumped via solvent pipe 21, through a heat exchanger 22, to the solvent inlet 1 of the second extraction tank 24. Solvent from the second extraction tank 24 is pumped via solvent pipe 19, via a heat exchanger 20, to the solvent inlet 1 of the first extraction tank. Solvent output from the first
5 extraction tank 24 is pumped to a waste solvent treatment process (not shown). Thus, the general flow direction of solvent in the extraction apparatus is in the reverse direction.

The internal recycling system for each extraction tank 24 is turned
10 on using pump 8. The recycled solvent passes through a heat exchanger 9 in order that the solvent temperature remains constant within each extraction tank 24. The recycled solvent is then returned to the same extraction tank 24 from which it was removed via a solvent recycle inlet 6. The action of the recycling pump 8 can also assist in moving tobacco material within each tank 24 in a
15 forward direction.

The solvent input and output flow rates should be equilibrated such that the solvent levels within the three extraction tanks 24 remain relatively constant during the extraction process. The solvent mass flow rate into the
20 extraction apparatus should be set so as to utilise the lowest volume of solvent required to achieve the required extraction efficiency of the process.

Optimally the ratio of tobacco material mass flow ratio:solvent mass flow rate within the extraction apparatus should be of the order of about 1:8.

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The screw conveyors 4 and the dewatering screws 14 in each

extraction tank should be set at the desired rotational speed. Optimally, the speed of rotation of the screw conveyor 4 should be such that the tobacco material to be extracted is resident in each extraction tank for approximately 5 minutes.

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Tobacco material, having an appropriate particle size is fed into the first extraction tank through tobacco inlet means 2. When the tobacco material is tobacco stem the appropriate particle size is between about 7/8 inches and about 2 inches. Tobacco material initially floats on the solvent surface until forced to
10 submerge in the solvent as the screw conveyor 4 rotates in a forward direction. The negative angle to the horizontal of the extraction tank 24 assists in forcing the tobacco material to submerge in the solvent. A negative angle up to about 5° is optimal for tobacco material having a particle size of between about 7/8 inches (22mm) and about 2 inches (51mm).

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Tobacco material is conveyed through the first extraction tank 24 by the action of the screw conveyor 4 until the extracted tobacco material is removed from the dewatering screw solvent tank 11 of the first extraction tank by means of the dewatering screw 14. Excess solvent flows back into the
20 dewatering screw solvent tank 11 via the central bore of the dewatering screw 14.

A press 15 is optionally attached to that end of the dewatering screw 14 that is distant from the extraction housing 3. The press is operable to
25 remove excess solvent from the tobacco material before the tobacco material is fed into the second extraction tank.

The process as described is repeated in the second and third extraction tanks.

5 A press 15 attached to the dewatering screw 14 of the final extraction tank 24 is operable to remove excess solvent from the tobacco material before the material exits the extraction apparatus.

10 The following example is provided in order to further illustrate one embodiment of the invention but should not be construed as limiting the scope thereof.

Example 1

15 Burley stem is initially cut to provide a particle size of between 7/8 inches (22mm) and 2 inches (51mm). The moisture content of the stem, before extraction, is in the region of 12.8%

20 Hot water, to be used as the solvent in the extraction process, is allowed to flood the extraction apparatus, the apparatus comprising 3 extraction tanks each set at a negative angle to the horizontal of 3°. The water is heated to about 80°C before entering the extraction apparatus, and the heat exchangers are calibrated to maintain the water at the selected temperature. The mass flow rates of the stem and water are set so as to maintain a stem:water ratio of 1:8 within the extraction apparatus.

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The rotational speed of each of the screw conveyors is set such that

the residence time of the stem in each stage of the extraction is 5 minutes.

Table 1 shows the results of extracting Burley stem via the process of the present invention, the process parameters being those of Example 1.

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Burley Stem	Residence Time in each extraction tank	TSNA (PPM) Control	TSNA (PPM) After extraction	% Change
	5	11.6	3.1	-73%
	10		5.1	-56%
	15		8.9	-24%

Table 2 shows the typical TSNA and nitrate reduction resulting from the extraction of Burley stem using the process of the present invention, the process parameters being described in Example 1.

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Burley Stem @ 12.8% Moisture Content	TSNA before extraction	TSNA after extraction	Nitrate before extraction	Nitrate after extraction
	14.8ppm	4.2 ppm (-72%)	4.47%	0.11% (-98%)

Claims

1. A multi-stage process for removal of soluble components from tobacco material, wherein tobacco material is sequentially substantially submerged in a solvent within a series of inclined extraction tanks, and wherein
5 said solvent is sequentially supplied to said series of extraction tanks in a direction opposite to that of the flow of said tobacco material.
2. A multi-stage process according to claim 1, wherein the tobacco material is sequentially substantially submerged in three extraction
10 tanks.
3. A multi-stage process according to claim 1 or claim 2, wherein each of said extraction tanks is substantially filled with solvent.
4. A multi-stage process according to any one of claims 1-3, wherein the tobacco material is conveyed through each of said extraction tanks
15 from an upstream to a downstream end of said extraction tank.
5. A multi-stage process according to any one of the preceding claims, wherein within each of said extraction tanks solvent and tobacco material flow in the same direction.
6. A multi-stage process according to claim 5, wherein said
20 solvent and said tobacco material, within each extraction tank, flow from an upstream to a downstream end of said extraction tank.
7. A multi-stage process according to any one of the preceding claims, wherein said tobacco material is continuously fed into a first extraction tank before undergoing sequential extraction in said first extraction tank, a
25 second extraction tank and optionally a third extraction tank.
8. A multi-stage process according to claim 7, wherein solvent

is continuously fed into said third extraction tank (if present) and is sequentially fed from said third extraction tank into said second extraction tank and said first extraction tank.

5 9. A multi-stage process according to any one of the preceding claims, wherein the residence time of said tobacco material in each of said extraction tanks is between about 5 minutes and about 15 minutes.

10 10. A multi-stage process according to claim 9, wherein said residence time is between about 5 minutes and about 10 minutes.

10 11. A multi-stage process according to claim 10, wherein said residence time is about 5 minutes.

15 12. A multi-stage process according to any one of the preceding claims, wherein the solvent temperature in each of said extraction tanks is in the range of about 70°C to about 95°C.

15 13. A multi-stage process according to claim 12, wherein said solvent temperature is between about 80°C and 85°C.

20 14. A multi-stage process according to any one of the preceding claims, wherein said solvent is selected from the group comprising water or water:alcohol mixtures.

20 15. A multi-stage process according to any one of the preceding claims, wherein the ratio of total mass flow rate of tobacco material to total mass flow rate of solvent in said series of extraction tanks is between about 1:2 and about 1:30.

25 16. A multi-stage process according to claim 15, wherein said ration is between about 1:4 and about 1:20.

25 17. A multi-stage process according to claim 16, wherein said ration is between about 1:4 and about 1:10.

18. A multi-stage process according to any one of the preceding claims, wherein said tobacco material is cut lamina, stem, dust or fines.

19. A multi-stage process according to claim 18, wherein when said tobacco material is stem, the stem has a particle size of between about 7/8
5 inches (22mm) and about 2 inches (51mm).

20. An extraction apparatus comprising a plurality of inclined extraction tanks wherein each of said extraction tanks is inclined at a negative angle to the horizontal and each extraction tank comprises an extraction housing, conveying means, tobacco material inlet and outlet means, and solvent inlet and
10 outlet means.

21. An extraction apparatus according to claim 20, wherein said apparatus comprises three extraction tanks.

22. An extraction apparatus according to claim 21, wherein said angle is up to about 5°.

15 23. An extraction apparatus according to claim 22, wherein said angle is between about 3° and 4°.

24. An extraction apparatus according to any one of claims 20-23, wherein said extraction housing is a hollow, substantially cylindrical tube.

25. An extraction apparatus according to any one of claims 20-
20 24, wherein said conveying means is a screw conveyor.

26. An extraction apparatus according to any one of claims 20-24, wherein said conveying means is a conveying belt, which conveying belt comprises tobacco material retaining means.

27. An extraction apparatus according to any one of claims 20-
25 26, wherein said conveying means is disposed within the extraction housing.

28. An extraction apparatus according to claim 25, wherein said

screw conveyor is axially aligned with the longitudinal axis of said extraction housing.

29. An extraction apparatus according to claim 25, wherein said screw conveyor is rotatably mounted to said extraction housing.

5 30. An extraction apparatus according to any one of claims 20-29, wherein said tobacco inlet means is a hopper or a conveyor belt.

31. An extraction apparatus according to any one of claims 20-30, wherein said tobacco outlet means is at a downstream end of said extraction tank.

10 32. An extraction apparatus according to claim 31, wherein said tobacco outlet means comprises dewatering means, by which means tobacco is removed from said extraction tank.

33. An extraction apparatus according to claim 32, wherein said dewatering means is a dewatering screw.

15 34. An extraction apparatus according to claim 33, wherein said dewatering screw extends into a dewatering means solvent tank, which dewatering means solvent tank forms an integral part of said extraction housing at the downstream end of said housing.

20 35. An extraction apparatus according to any one of claims 33-34, wherein said dewatering screw comprises a hollow, helicoid screw operable to remove tobacco from said extraction tank.

36. An extraction apparatus according to any one of claims 33-35, wherein said dewatering screw is set at a positive angle to the horizontal such that, in operation, excess solvent flows back into said extraction tank whilst
25 tobacco material is removed from said tank.

37. An extraction apparatus according to any one of claims 32-

36, wherein said dewatering means further comprises a press at an end thereof, which end is distant from said extraction housing.

38. An extraction apparatus according to any one of claims 20-37, wherein each of said extraction tanks is provided with solvent recycling means.

39. An extraction apparatus according to any one of claims 20-38, wherein each of said extraction tanks comprises solvent outlet means, which outlet means are located such that solvent exits each extraction housing from the dewatering screw solvent tank.

40. An extraction apparatus according to any one of claims 20-39, wherein the solvent outlet means of one extraction tank is joined to the solvent inlet means of the preceding tank via a solvent pipe.

41. An extraction apparatus substantially as described hereinabove with reference to Figures 1 and 2.

42. A multi-stage process substantially as described hereinabove with reference to Example 1.