(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 646 049 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
03.02.1999 Bulletin 1999/05

(21) Application number: **93910076.4**

(22) Date of filing: **08.06.1993**

(51) Int. Cl.[6]: **B07B 15/00**, B07C 5/342, D21B 1/02

(86) International application number:
PCT/FI93/00247

(87) International publication number:
WO 93/25324 (23.12.1993 Gazette 1993/30)

(54) A METHOD FOR MANUFACTURING LOW BARK CONTENT WOOD CHIPS FROM WHOLE-TREE CHIPS

VERFAHREN ZUM HERSTELLEN VON HOLZSPÄNEN MIT NIEDRIGEM RINDENGEHALT AUS BAUMSCHEIBEN

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(84) Designated Contracting States:
AT CH DE DK ES FR GB IE IT LI NL PT SE

(30) Priority: **08.06.1992 FI 922636**

(43) Date of publication of application:
05.04.1995 Bulletin 1995/14

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Description

[0001] The object of the invention is a method for manufacturing low bark content wood chips from whole-tree chips, in which method there are two or more sequential separation stages, which can be divided into pre-separation leading to a bark content of less than 10 % and a final cleaning, and in which the pre-separation includes at least pneumatic separation as well as fines sieving and the final cleaning includes sorting based on colour separation or generally speaking on optical separation. In particular the invention is directed towards a cleaning method for birch and pine whole-tree chips.

[0002] In present timber harvesting methods a considerable amount of the timber mass, in this case timber fibre biomass, is left in the forest, because it is unprofitable to collect it. When industry in Finland uses annually about 50 million m^3 of stemwood with bark, about 23 million m^3 of felling waste remains in the forest, of which it is estimated that half could be brought to the mill by using new harvesting technology.

[0003] Up until now cellulose has been manufactured from stemwood with bark, from which the bark can easily be removed by means of drum debarking. The exploitation of waste remaining in the forest cannot economically be connected to this chain.

[0004] So far it has not proved possible to use the mass obtained from forest waste, i.e. from crushed small trees and branches, in the manufacture of cellulose, because after even modern cleaning methods the bark content of the mass has been too great. Fines sieving achieves a bark content of only about 10 %. It is true that patent publications US 4,266,675, CH 643 160, SU 756 460, and SU 531 230 present various kinds of particle and even chip mass separators which operate on the principle of recognizing the differences in colour of the particles, in this case of the chips. These do not always give satisfactory results in the sorting of whole-tree woodchips with yield staying low and the remaining bark content staying high. It is not possible to achieve both a good yield and a high degree of cleanliness by purely adjusting the selection criteria of the separator.

[0005] From US 4,332,353 a procedure for mechanically raising the wood content in wood chips is known comprising the steps of:

- screening the wood chips in a disc sieve removing from the chips the stones and other bodies which are oversize or would damage the equipment;

- grinding the chips in a dry grinder drum by means of attrition and impact treatment with grinding bodies of appropriate shape and weight such as balls for instance, for detaching the bark and green matter from the wood material, and at the same time the bark pieces, leaves and needles are comminuted;

- screening the chips wherein the chips are sorted according to the thickness. Chips with accessive thickness are conducted to a disc chopper, are cruched there to small size and returned to said screening;

- plain sifting of the material that has passed the thickness sorting screen, where separation sifting is accomplished. The bark and green matter that has been ground finely in the grinder drum treatment as well as other fine materials such as sand, are separated from the chip material intended to be incorporated in the product. This product present a wood content up to and 95% after separation.

[0006] This known method comprises a pre-separation, a grinding treatment and a final separation.

[0007] From SU-A-12 15762 an optical sorting unit for wood-chips is known having a convoyer, a light source for lighting either size of the convoyer, wherein the convoyer is made of parallel belts. Photoreceivers are placed in pairs at light conductor outlets, which are situated between convoyer belts perpendicular to its surface. By this optical sorting unit the light energy efficiency is increased and the operation reliability is improved. The unit can be used in timber and cellulose-paper industry for wood-chips cleaning from bark, rotten pieces and etc.

[0008] Because timber mass used for cellulose has a considerably higher value than that used as fuel, there has been an obvious attempt to find a suitable cleaning method, by means of which chips suitable for cellulose manufacture with a bark content of less than 1% and a high yield can be obtained from whole-tree, i.e. forest chips.

[0009] The intention of this invention is to create a new kind of method, by means of which the above aims can be achieved. The characteristic features of the method in accordance with the invention are presented in the accompanying Patent Claim 1. From the point of view of separation in accordance with the invention it is essential that the forest chips are first treated by grinding in order to remove the bark and by means of a good preseparation method before colour difference sorting because this is not able to remove a high bark content from the mass. At this stage pneumatic separation is essential because light and thin particles, such as birch bark, cannot be separated in any other way and are great inconvenience in later separation processes and especially in cellulose manufacture. Grinding creates internal cracks in the chips, in which case chemicals are absorbed more rapidly during cellulose cooking. Grinding is carried

out alternatively either by a plate grinder or a vibrator cone crusher, which simultaneously reduces the particle size. At the present moment the former appears the better of the two.

[0010] In addition to bark colour difference separation, separators based on the shape and density of chips can be advantageously used, by means of which knot pieces among other can be removed.

[0011] In what follows the invention is illustrated with the aid of the accompanying figures in which

Figure 1 shows the chip cleaning schematically
Figure 2 shows one kind of colour difference sorter
Figure 3 shows schematically a simplified version of the cleaning equipment

[0012] The following is a table illustrating the grinding of whole-tree chips.

	Pine whole-tree chips	
	Original p-%	Ground p-%
Branches with bark	5,4	2,3
Loose bark	10,0	11,7
Chips with bark	15,1	2,0
Debarked chips	59,0	60,7
Fines	10,7	23,3

[0013] In this example pine whole-tree chips are ground in a plate grinder with a blade gap of 7 mm. As can be seen from the above table, the share of knots and chips with bark in whole-tree chips treated by grinding is reduced considerably. It is true that the share of bark-free chips has not increased by a great deal, but this was due to the fact that at the beginning the chip size was at an acceptable level and during grinding the chip size was partly reduced to less than the acceptable level. Because of this it is advantageous to select a chip size for the whole-tree chips being treated that is too great, because the grinding nonetheless reduces the chip size. In that case there would be an obvious increase in the share of debarked chips.

[0014] Depending on the mill, different sizes of chips are used, being in general 6 - 8 mm. The share of chips that are too thick is seen in the share that remains in the sieve. This can be reduced considerably, because in grinding the chip thickness is reduced to an acceptable level. The thickness of the chips can be adjusted by setting the blade gap of the grinder as desired, advantageously to the zone 6 - 14 mm.

[0015] There are numerous methods for pre-separation, from which the aforementioned pneumatic separation and vibrator sieve have been selected for Figure 1. Pneumatic separation can be regarded as being essential, because certain light particles, such as leaves and birch bark, cannot be separated by any other means.

[0016] Colour difference separation is carried out by equipment that is in itself of a known type, in which a conveyor belt moves the mass beneath an optical unit that notes the different colour of bark on the belt. The piece of bark is removed from the rest of the mass when it comes to the end of the conveyor, by means of a jet of air. The following describes one known type of colour difference sorter, of the type Sortex 4500. The principal structure of this colour difference sorter is shown in the accompanying Figure 2. The principal components of the device are a conveyor belt 1, a control unit 2, an optical unit 3, air ejectors 4, a fluorescent light 5, and operating machinery 6. The pre-cleaned wood chip mass is fed to the conveyor belt 1, which moves it at an even speed under optical unit 2. The wood chip mass is illuminated in addition by a fluorescent light 5, in order to achieve a better resolution. The control unit directs the operating machinery 6, and at a calculated time starts a corresponding air ejector 4, by means of which a bark particle is made to deviate from the direction of the main mass, and in this was the mass is separated into different fractions.

[0017] Tests made with a colour difference sorter used wood chips from which pine needle tips, leaves, and fines less

than 7 mm had been removed, as had particles thicker than 8 mm and longer than 45 mm. The bark content of the samples of both species of wood was about 5 %. In sorting pine a bark content of 0,6 % and a yield of 65,5 % was achieved with approved particles. With approved birch particles the bark content was 1,9 % and the yield 63,8 %. In order to improve the yield a second colour difference sorter is used, which removes rejects (share 54,7 %) with a high bark content (with pine 24,7 %) and the approved fraction is fed back to the grinder. This kind of return is necessary, because often the aforementioned bark content is due to chips with bark, from which the bark must thus first be removed.

[0018] When whole-tree wood chips are being used, pre-separation is required to reduce the bark to less than 8 % using present methods. The final cleaning of surface plank, i.e. logs with bark, wood chips can on the other hand begin with a bark content of as much as 10 %, because the pieces of bark are large.

[0019] A thermal image processing system can be used for recognizing and separating the density of chips, when the chip mass flow is first of all heated. The denser pieces, i.e. in practice the knots, then appear at a different temperature to the rest of the mass. Outline recognition is in itself a known technique, but it demands powerful processors and its own program adapted to wood chip mass sorting.

[0020] In brief, the significance of the invention can be described as being that by means of it timber raw material is exploited in a more precisely refined form. By means of the invention cellulose chips with a 70 % yield can be achieved (bark content 0,5 %), whereas known solutions with whole-tree chips achieve at most a yield of 45 % with a bark content of 3,0 %. The method in accordance with the invention should preferably be compared to present stemwood harvesting, in which using drum grinding the same bark content of 0,5 % is naturally achieved, but the yield calculated on the basis of the entire biomass remains at 40 %.

[0021] Figure 3 shows the equipment in Figure 1 simplified in that in it only one colour difference separator is used, the approved fraction of which is removed from the process as cellulose chips, and the reject, i.e. chips containing bark, is returned to the grinder. As the quality of colour separation is improved and the reject is reduced it can be removed directly as fuel fraction.

Claims

1. A method for manufacturing low bark content wood chips from whole-tree chips, in which method there are two or more sequential separation stages, which can be divided into pre-separation with a bark content of less than 10 % and final cleaning, and there is a grinding treatment in order to detach the bark from chips, characterized in that the pre-separation consists of at least a pneumatic separation and the grinding treatment takes place before the pneumatic separation and it is done by a plate grinder or a vibrating cone crusher, which simultaneously reduces the particle size of the bark, and the final cleaning includes sorting based on colour difference.

2. A method in accordance with Patent Claim 1, characterized in that the colour difference separation includes two sequentially connected and so-called cascade connected stages, i.e. in the first stage clean chips are removed from the cycle and in the second stage the high bark content reject is removed.

3. A method in accordance with Patent Claim 2, characterized in that the first of the cascade connected colour difference separation is adjusted to separate clean chips with a bark content of less than 1 % and that the reject from this stage is fed to a second stage, the fraction approved by the colour difference separator of which is led back to treatment and the reject mass with a high bark content is removed from treatment.

4. A method in accordance with Patent Claim 3, characterized in that the approved fraction from the second stage is led back to the grinder in order to remove the bark attached to the chips.

5. A method in accordance with Patent Claim 4, characterized in that the blade gap in the plate grinder or correspondingly the opening gap in the vibrating cone grinder is in the zone 6 - 14 mm.

6. A method in accordance with Patent Claim 5, characterized in that the thickness of the chip size of the whole-tree chips is initially selected in such a way that the share of the chips remaining in the 6 - 8 mm (depending on the mill) gap sieve is reduced to one third.

7. A method in accordance with one of Patent Claims 1 - 6, characterized in that in the final cleaning separation is used that is also based on the recognition of the density and/or the shape of the chips.

Patentansprüche

1. Verfahren zur Herstellung rindenarmer Holzhackschnitzel aus Ganzbaumhackschnitzeln, das zwei oder mehr auf-

einanderfolgende Trennungsstufen aufweist, die in eine Vortrennung auf einen Rindengehalt unter 10 % und eine Endreinigung unterteilt werden können, und bei dem zwecks Ablösens der Rinde von den Hackschnitzeln eine Mahlgerätbehandlung des Guts erfolgt, dadurch gekennzeichnet, dass die Vortrennung wenigstens ein Windsichten umfasst und die Mahlgerätbehandlung vor dem Windsichten geschieht und mit einem Scheibenrefiner oder einem Rüttelkegelbrecher, der gleichzeitig die Rindenpartikelgröße reduziert, durchgeführt wird und zur Endreinigung eine Sortierung nach Farbunterschied gehört.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, dass die Sortierung nach Farbunterschied zwei hintereinander und in Kaskadenschaltung angeordnete Stufen umfasst, wobei in der einen Stufe aus dem Kreislauf die sauberen Hackschnitzel und in der anderen Stufe das rindenhaltige Rejekt abgetrennt werden.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, dass von den kaskadengeschalteten auf Farbunterschied basierenden Sortierern der erste eingestellt ist, reine Hackschnitzel mit einem Rindengehalt unter 1 % abzutrennen, und das Rejekt dieser Stufe der zweiten Stufe zugeführt wird, deren bei der Sortierung nach Farbunterschied gewonnenes Akzept einer erneuten Behandlung zugeführt wird, während das stark rindenhaltige Gut als Rejekt aus dem Behandlungszyklus genommen wird.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, dass das Akzept der zweiten Stufe zwecks Ablösens der an den Hackschnitzeln sitzenden Rinde erneut der Mahlgerätbehandlung zugeführt wird.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, dass die Weite des Mahlspaltes des Scheibenrefiners beziehungsweise des Rüttelkegelbrecherspaltes zwischen 6 und 14 mm beträgt.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, dass die Dicke der Ganzbaumhackschnitzel ursprünglich so gewählt wird, dass der Anteil des Siebüberlaufs auf dem betriebsspezifischen Schlitzsieb (6-8 mm je nach Betrieb) auf ein Drittel gedrückt wird.

7. Verfahren nach irgendeinem der Ansprüche 1 bis 6, dadurch gekennzeichnet, dass bei der Endreinigung auch eine Trennung der Hackschnitzel nach Dichte und/oder Form der Schnitzel zur Anwendung gebracht wird.

Revendications

1. Procédé pour fabriquer des copeaux de bois à faible teneur en écorce à partir des copeaux provenant de troncs entiers, dans lequel il y a deux ou plusieurs ètages consécutifs de séparation qui peuvent être divisés en une pré-séparation avec une teneur en écorce de moins de 10% et une purification finale, et un traitement moulant afin de détacher l'écorce des copeaux, caractérisé par le fait que la pré-séparation consiste au moins une séparation pneumatique, en ce que le traitement moulant s'éffectue, avant la séparation pneumatique, par un broyeur à plaque ou par un broyeur vibratant à cône qui réduit simultanément les dimensions des particules d'écorce, et en ce que la purification finale inclût un triage basé sur la difference de couleur.

2. Procédé selon la revendication 1, caractérisé par le fait que la séparation par difference de couleur contient deux ètages reliés consécutivement l'un à l'autre et accouplés "en cascade", c'est à dire que dans l'étage initial, les copeaux purifiés sont retirés du cycle et que dans le deuxième stage les déchets à grande teneur en écorce sont retirés.

3. Procédé selon la revendication 2, caractérisé par le fait que le premier des séparateurs par difference de couleur accouplés en cascade est reglé pour séparer les copeaux de bois purifiés à une teneur en écorce de moins de 1 % et que le déchet de cet étage est introduit dans le deuxième étage dont une fraction approuvée par le séparateur par couleur est renvoyée au traitement alors que le déchet à grande teneur en écorce est retiré du traitement.

4. Procédé selon la revendication 3, caractérisé par le fait que la fraction approuvée par le deuxième étage est renvoyée au broyeur pour que l'on retire l'écorce attachée aux copeaux de bois.

5. Procédé selon la revendication 4, caractérisé par le fait que la distance entre les lames du broyeur à plaque ou l'interstice correspondant du broyeur vibratant à cône est dans la zone de 6 à 14 mm.

6. Procédé selon la revendication 5, caractérisé par le fait que l'épaisseur du format des copeaux provenant de troncs entiers est initialement choisie dans une façon que la partie restante dans la zone de 6 à 8 mm (dépendant de

l'usine) du crible troué est réduite au tiers.

7. Procédé selon l'une des revendications 1 - 6, caractérisé par le fait qu'une séparation basée sur l'identification de la densité et/ou la forme des copeaux de bois est aussi utilisée à la purification finale.

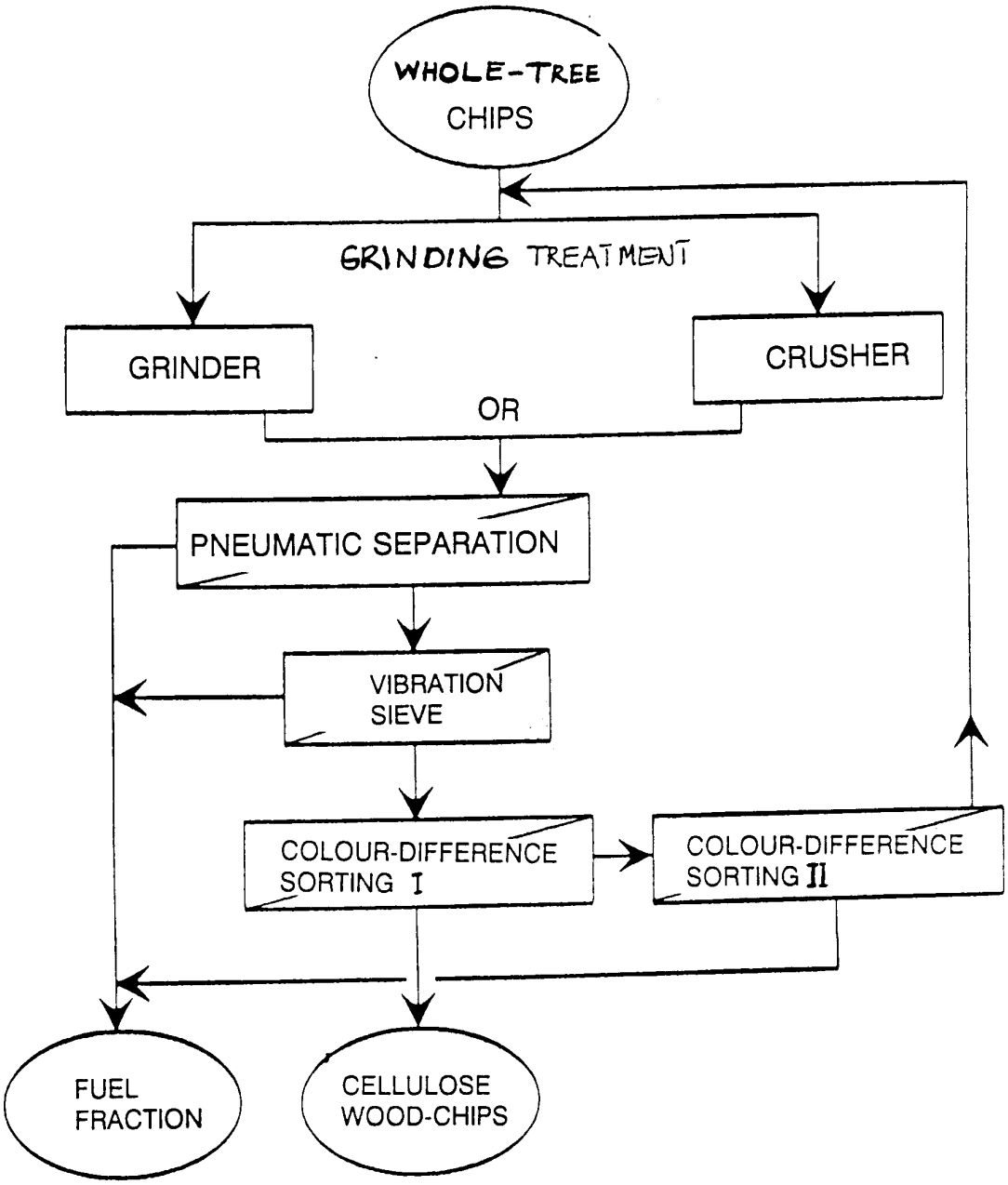
WHOLE-TREE
CHIPS
GRINDING TREATMENT
GRINDER
CRUSHER
OR
PNEUMATIC SEPARATION
VIBRATION
SIEVE
COLOUR-DIFFERENCE
SORTING I
COLOUR-DIFFERENCE
SORTING II
FUEL
FRACTION
CELLULOSE
WOOD-CHIPS

Fig. 1

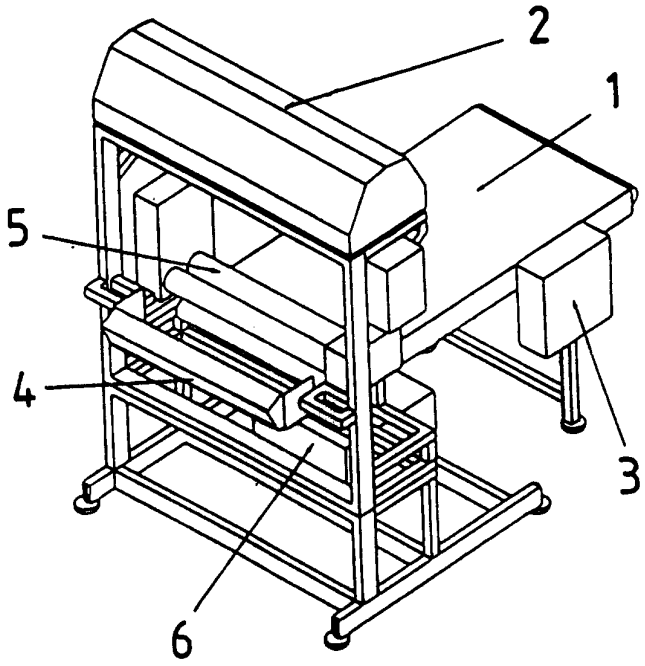

FIG. 2

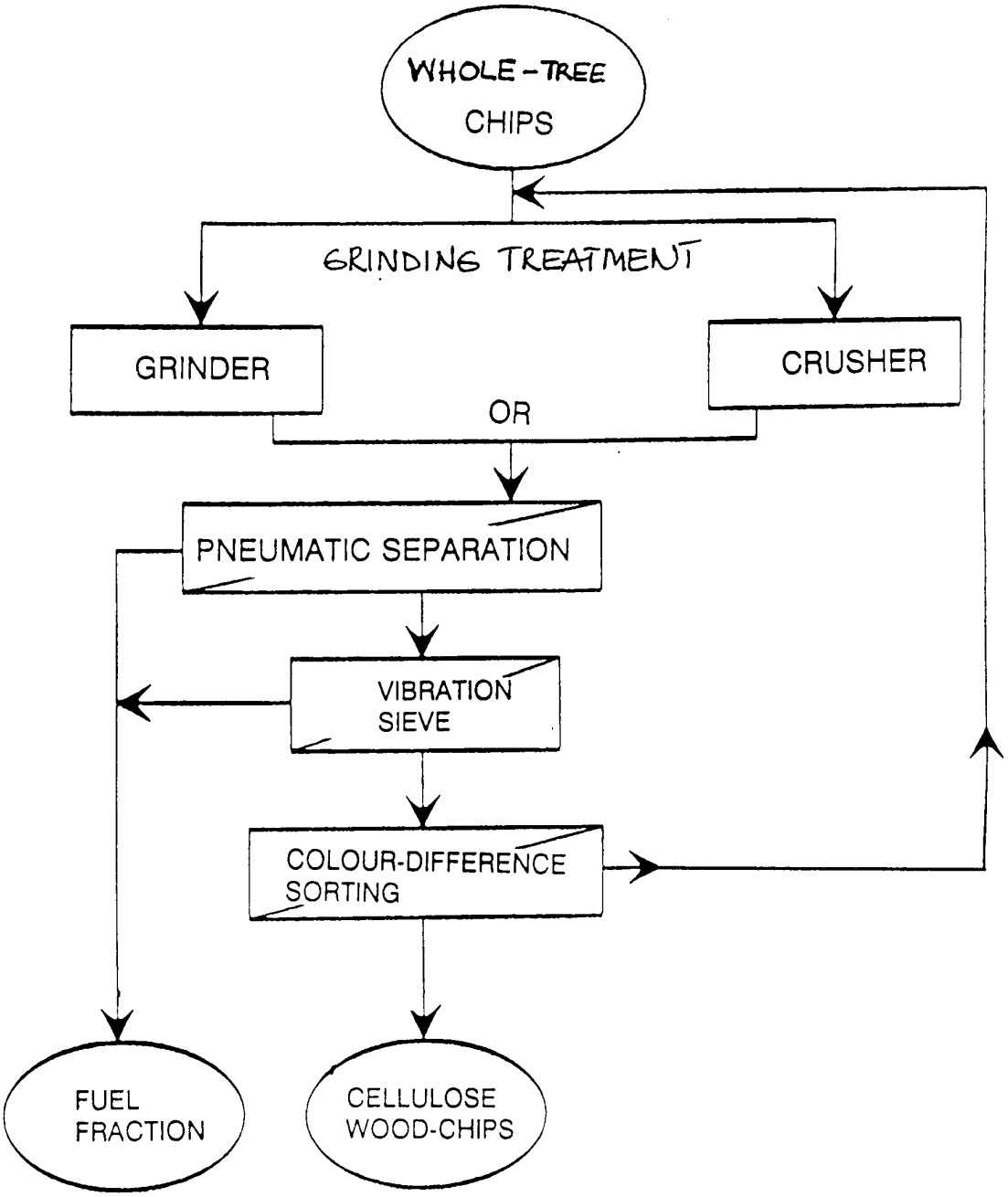
WHOLE-TREE CHIPS
GRINDING TREATMENT
GRINDER
CRUSHER
OR
PNEUMATIC SEPARATION
VIBRATION SIEVE
COLOUR-DIFFERENCE SORTING
FUEL FRACTION
CELLULOSE WOOD-CHIPS

Fig. 3