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(54) **LOW SPEED LOW INTENSITY CHIP REFINING**

RAFFINIERUNG VON HOLZSPÄNEN BEI NIEDRIGER GESCHWINDIGKEIT UND INTENSITÄT
RAFFINAGE DE COPEAUX A FAIBLE VITESSE ET A FAIBLE INTENSITE

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US-A- 4 661 911 US-A- 5 624 616</p> <ul style="list-style-type: none">• MILES K B ET AL: "Refining intensity, energy consumption, and pulp quality in two-stage chip refining" TAPPI JOURNAL, vol. 74, no. 3, 1991, pages 221-230, XP002114470 cited in the application |
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Description

[0001] The present invention relates to the mechanical refining of wood chips to produce wood pulp and more particularly, to a method of producing uniform and superior quality pulp from wood chips with disc refiners employing low intensity refining.

BACKGROUND ART

[0002] In recent years there has been a considerable amount of both theoretical and experimental research into the factors governing fibre residence time in wood chip refiners. This has led to the concept of refining intensity, defined as the specific energy delivered per bar impact. The constitutive equations for material flows within refiners developed by Miles and May (J. Pulp Paper Sci. 16(2): J63(1990) and Paperi ja Puu 73(9):852 (1991) can be used to calculate pulp velocity and the corresponding residence time of the pulp in the refiner. The residence time determines the specific energy per bar impact which Miles and May defined as refining intensity. Currently, many developments in mechanical pulping are focussed on reducing energy consumption while maintaining pulp quality at a desirable level. The refining intensity, which is a deciding factor for the quality of pulp produced at a given total specific energy, is itself highly dependent on the rotational speed of the refiner. In current commercial systems, the rotational speed of the refiner is determined by the frequency of the electrical supply, so that double disc refiners run at either 1200 or 1500 RPM and single disc refiners at 1500 or 1800 RPM. Therefore, regardless of the process requirements, the refining intensity is fixed by the system design and local generating frequency.

[0003] Jones et al (US 3,411,720) disclose that mechanical pulp with greater strength could be produced by devising a refining process in which the amount of energy absorbed by the wood material is increased. They achieve this by increasing the residence time of the pulp in the refiner using a combination of sinuous plates or tapered plates and control rings on the periphery of the plates. Although they specified relative speeds of between 900 and 3600 RPM the process was never proven to be practical or effective.

[0004] Other methods to change the pulp residence time and the applied energy by changing the steam flow within zones in a refiner, have been reported. US 5,335,865 discloses removing some of the steam from a first refining zone before it enters a second zone, or from the first two refining zones before entering a third (US 5,248,099). These methods are based on the mistaken belief that steam and pulp velocities are equal. Steam flow has little effect on either average pulp velocity or residence time as calculated by Miles, Paperi ja Puu 73 (9): 852 (1991).

[0005] US 2,035,994 discloses using variable disc speed to control pulp throughput using a stock refiner.

A stock refiner is different from a mechanical disc refiner in that the stock refiner is employed to refine pulp while a mechanical disc refiner is used to refine wood chips. The process operates at low consistencies (3 to 6%) and rotational speeds (300 to 900 RPM). While these conditions are suitable for small modifications and improvements to pulp fibres before papermaking they are not suitable for refining wood chips into pulp fibres.

[0006] In an effort to circumvent the limitations imposed by electrical frequency and to reduce specific energy consumption in a single disc refiner, one equipment supplier has advocated an increase in refining intensity by employing a gearbox to raise the rotational speed to 2300 RPM. Similarly, in a double disc refiner (US 5,167,373), an increase in feed-end speed from 1200 to 1800 RPM (US 5,167,373) is advocated. However, these approaches do not account for situations where a fixed high level of refining intensity may not be appropriate for different raw materials and end product requirements.

[0007] Operating at higher than conventional disc speeds has been most effective when the first refining stage was operated at high refining intensity and the second stage was operated conventionally. This is described in Tappi Journal 74(3):221(1991) and J. of Pulp Paper Sci. 19(1):J12(1993). The optimum energy saving at desired pulp and fibre properties was obtained by employing a smaller portion of the total specific energy in the first, high intensity stage. A typical split in specific energy between the first and second stages of refining would be 40/60. Increasing further the refining intensity or the proportion of the specific energy applied in the first stage lowers the total energy required to reach a given freeness. However, it also lowers the average fibre length and pulp strength, limiting the advantage of the energy savings that was reported.

[0008] US Patent No. 5,540,392, issued to Broderick et al. discloses that it is possible to reduce energy by up to 18% in a two-stage refining system. At least 65% of the total energy is applied in a low intensity first stage refiner operating at conventional disc rotational speeds. Low refining intensity was achieved by raising the consistency from 26 to 30%. The remaining energy is applied in a high intensity second stage refiner. The pulp properties are reported to be at least as good as or better than that produced by conventional refiners although all their examples are for highly sulphonated pulps.

[0009] US Patent No. 5,624,616, issued to Brooks, discloses a method of co-refining dry urban wood chips to produce fibres suitable for fibred products using a double rotating disc refiner in a single refining stage. As stated in this disclosure, it relates only to dry wood chips which are very different to "green" wood chips; and it relates to producing material suitable for producing fibreboard products, such that as described only low energy is required.

[0010] There is no known approach in the prior art that addresses the need to reduce refining intensity below

conventional levels in order to improve the quality of wood fibres.

DISCLOSURE OF THE INVENTION

[0011] This invention seeks to provide a method for mechanically refining wood chips to produce wood pulp exploiting low refining intensity achieved by rotating impact member which are rotated at speeds lower than conventional speeds.

[0012] Still further this invention seeks to provide an improvement to the conventional methods for refining wood chips into pulp or individual pulp fibres by mechanical means in a single or double disc refiner. More specifically, the improvement comprises increasing pulp quality.

[0013] According to the invention there is provided a method of mechanical refining of wood chips as defined in accompanying claim 1. Further features of the invention are defined in claims 2 to 13.

[0014] A described embodiment of the invention seeks to control the refining intensity in at least two or more distinct refining stages employing low intensity in at least two of the refining stages, one of the stages being the last.

[0015] A described embodiment also seeks to control refining intensity in two or more distinct refining stages employing low refining intensity in a pre-refining stage and a final refining stage

[0016] A still further embodiment of the invention seeks to control refining intensity in three distinct refining stages employing low refining intensity in each stage.

[0017] A still further embodiment of this invention seeks to employ low refining intensity in refining rejects in a multiple stage refining operation.

[0018] The invention seeks to employ low refining intensity in distinct refining stages carried out by rotating the discs of a double disc refiner or the disc of a single disc refiner at rotational speeds that are lower than that conventionally employed.

[0019] There is also disclosed a method of refining wood chips to wood fibre pulp with monitoring of a fibre quality parameter.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] The invention provides a refining process capable of improving pulp fibre quality, to the likeness of kraft fibre, by low intensity refining enabled by a speed reduction of the disc or discs in a refiner. This unexpected finding was first discovered while employing low intensity refining at disc speeds of less than 1200 RPM in a single stage refiner.

[0021] Subsequently, it has been found that the improvement of pulp-fibre quality is also evident in refining systems employing distinct multiple refining stages provided that at least the final refining stage is carried out

at low intensity enabled by a reduction of disc speed to below conventional speeds. It has also been discovered that fibre quality was improved in a multi stage refining system when each refiner in a multiple series was operated at low refining intensity enabled by a reduction of disc speed to less than conventional operating speeds.

[0022] Double disc refiners conventionally operate at disc rotations of 1200 RPM or more. In the present invention, when employing a plurality of double disc refiners in sequence, the discs rotate at less than 1200 RPM, preferably not more than 1150 RPM, more preferably 850 to 1000 RPM and most preferably about 900 RPM to provide the desired rotation of the impact members which are supported on the rotating discs.

[0023] Single disc refiners conventionally operate at a disc rotation of 1500 RPM or more, and typically at 1500 RPM or 1800 RPM. In the present invention, when employing a plurality of single disc refiners in sequence, the disc rotates at less than 1500 RPM, preferably not more than 1450 RPM, more preferably at 1100 to 1300 RPM and most preferably at about 1200 RPM.

[0024] In practice it is most expedient at present to employ speeds which are multiples of 300 RPM, because equipment manufacturers market disc refiners with motors which provide operational speeds which are multiples of 300 RPM; for example, 900 RPM, 1200 RPM, 1500 RPM and 1800 RPM. In general operating at speeds which are multiples of 300 RPM requires additional equipment permitting variation of the output of the motor in the commercially available disc refiners.

[0025] In general the refining of wood chips to wood pulp comprises breaking the wood chips down into the component fibres, followed by fibre development in which the fibres are fatigued to render them flexible and collapsible.

[0026] This invention can also be implemented by applying a constant low intensity, low energy treatment in a pre-refiner by utilizing a fixed rotational speed of less than 900 RPM and preferably at 600 RPM.

[0027] The pre-refiner provides a preliminary gentle refining prior to the main refining stage or stages.

[0028] In another embodiment of this invention a rejects refiner is operated at low intensity enabled by a reduction in disc speed to less than 1200 RPM to yield pulp fibre of extremely high quality. The rejects are, in particular, screen rejects from a wood chip pulp of the main line refiners.

[0029] All or any combination of the above processes can be implemented to maximize the quality of the pulp fibres to a level heretofore non-existent commercially.

[0030] A preferred embodiment applied to existing commercial TMP (thermo-mechanical pulp) refiner installations employing double disc refiners would be the operation of the secondary and/or tertiary refiner in such an installation at low intensity enabled by a reduction in disc speed to less than 1200 RPM. In the commercial installation the refining intensity is too high for the fibres

at that point in their development. It has been discovered that by employing low refining intensity according to this invention the secondary and/or tertiary refiner can be fully loaded when required.

[0031] In each of the above cases low intensity refining is enabled by a speed reduction of the disc refiner which typically is achieved by known means in the art such as a variable frequency AC drive, a gear box or a simple set speed motor design, whichever is most appropriate.

[0032] The present invention is not necessarily directed to saving refining energy per se, although some energy saving can be achieved. The invention has major application in that it may be used to direct energy towards fibre quality development rather than fibre damage, as is the case with conventional refining systems.

[0033] In an apparatus embodiment of the present invention employing a double disc refiner both discs are rotated at less than 1200 RPM and preferably at 900 RPM in order to achieve a desired low refining intensity required to direct the applied energy towards fibre quality development.

[0034] In another apparatus embodiment of this invention employing a single disc refiner the disc is rotated at less than the conventional 1800 RPM or 1500 RPM, and more especially at less than 1500 RPM.

[0035] Thus, there is provided in the present invention a variety of novel features which can afford significantly greater on-line control of the refining process to produce quality fibre. Additionally, pulp quality control can be greatly enhanced through feedback adjustments of motor rotational speed, i.e., refining intensity. Indeed this will provide another variable, besides specific energy, that can be manipulated to control pulp properties. This will give the possibility to independently control on-line two of the pulp properties such as freeness and average fiber length which is an advantage over conventional control where only one variable, specific energy, is adjusted to control only one pulp property such as freeness.

[0036] In a typical refiner installation a device is employed which monitors pulp quality by measuring fibre length and specific surface or freeness and maintains a set quality standard by motor load, for example, by plate gap adjustment. If now, for example, with the present invention the fibre length is sensed as being too low, a signal is sent to the motor speed controller of the refiner, to reduce RPM thereby lowering refining intensity and thus restoring fibre length to a preset value. Such monitoring devices are commercially available. Other fibre quality parameters may be sensed in the same way, for example, flexibility or coarseness and a signal sent to the motor speed controller to change the RPM to restore the quality parameter to a desired level.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037]

- 5 Fig 1. Illustrates graphically how low intensity single stage refining at 900 RPM permits higher energy to be applied at a given freeness than conventional single stage refining at 1200 RPM;
- 10 Fig 2. Illustrates graphically how in single stage low intensity refining more long fibres are retained at a given specific energy than in conventional single stage refining;
- 15 Fig. 3 Illustrates graphically how more energy can be put into the pulp at a given freeness by low intensity refining at 600, 900 and 900 RPM in three distinct stages as compared to conventional 1200 RPM refining;
- 20 Fig. 4 Illustrates graphically similar burst/freeness relationships obtained with three stage low intensity refining and conventional refining;
- 25 Fig. 5 Illustrates graphically that three stage low intensity refining can provide substantially higher tear strength than conventional refining;
- 30 Fig. 6 Illustrates graphically that three stage low intensity refining increases tear/burst levels over conventional refining;
- 35 Fig. 7 Illustrates graphically how, using pre-steamed chips and two stages of low intensity refining at 900 RPM produces better pulp quality than two stage conventional refining at 1200 RPM;
- 40 Fig. 8 Illustrates graphically how without chip pre-steaming, two stages of low intensity refining at 900 RPM produces better pulp quality than two stage conventional refining at 1200 RPM;
- 45 Fig. 9 Illustrates graphically how, in two stage refining, better pulp is produced when the 1200 RPM primary stage is followed by low intensity secondary refining at 900 RPM instead of conventional secondary refining at 1200 RPM;
- 50 Fig. 10 Illustrates graphically that better pulp quality is obtained when TMP rejects are given low intensity refining at 900 RPM than when conventionally refined at 1200 RPM;
- 55 Fig. 11 Illustrates graphically how using three distinct stages of low intensity refining at 600, 900, and 900 RPM permits more energy to be applied to jack pine than conventional refining at 1200 RPM;
- Fig. 12 Illustrates graphically the refining operation of Fig. 11 to show that, at the same freeness, jack pine burst is improved by refining at low intensity;
- Fig. 13 Illustrates graphically the refining operation of Fig. 11 to show that, at the same freeness, jack pine tear is improved by refining at low intensity;
- Fig. 14 Illustrates graphically the refining operation of Fig. 11 to show that tear strength of jack pine at a given burst value is much better when refining at low intensity than conventional refining;
- Fig. 15 Illustrates graphically that, at a sulphonate

content of 2 percent (140 g/l solution), low intensity CMP refining permits higher tear strength to be obtained at high burst values;

Fig. 16 Illustrates graphically that, at a sulphonate content of 0.9 percent (35 g/l solution), low intensity CMP refining gives greatly enhanced tear strength, similar to that of conventional refining at 2 percent sulphonate content;

Fig. 17 Illustrates graphically a comparison of results achieved employing two sequential low intensity refining stages in accordance with the invention, and a comparison in which a lower intensity stage is followed by a high intensity stage; and

Fig. 18 Is a schematic of a control system for practicing the method of the present invention in accordance with one embodiment thereof.

EXAMPLES

[0038] Pilot plant trials to study low intensity refining were conducted on an atmospheric 36 inch (91.44 cm) double disc refiner which in conventional operation utilizes a disc rotational speed of 1200 RPM. All experiments were done with standard Bauer pattern 36104 refiner plates. A constant discharge consistency of 25 percent was maintained throughout the investigation and, unless otherwise noted, all chip refining was done with black spruce chips which had been pre-steamed at 138°C for 10 minutes.

[0039] In Fig. 1, freeness has been plotted against specific energy to compare conventional single stage refining with a double disc refiner at a disc speed of 1200 RPM, to low intensity single stage refining at a disc speed of 900 RPM. At the same freeness, the pulp made at the low refining intensity requires more energy than that produced with conventional conditions. This is because low intensity refining promotes fibre development, rather than fibre cutting, as shown by the plot of long fibre content against specific energy in Fig. 2.

[0040] Higher energy consumption to a given freeness is also evident in Fig. 3 which compares a single stage of conventional refining with a double disc refiner at 1200 RPM to three stages of low intensity refining with disc speeds of 600, 900, and 900 RPM in the first, second, and third stages, respectively. The conventional and low intensity pulps have the same burst-freeness relationship, as shown in Fig. 4 which demonstrates that more energy can be applied to the pulp with low intensity refining than conventional refining. The tear index of pulp made with low intensity refining is significantly higher than that made at conventional intensity as shown in Fig. 5. Low intensity refining gives both a higher tear index and burst than refining at conventional intensity, as shown in Fig. 6.

[0041] Operating both the primary and secondary double disc refiners at lower intensity produced by disc speeds of 900 RPM produces pulp with both a higher burst and tear than primary and secondary stages op-

erated at conventional intensity as shown in Fig. 7. Similar trends are obtained when no chip presteaming is done, as shown in Fig. 8.

[0042] It has also been found that strength properties can be enhanced in two stage refining by operating the primary refiner of a double disc refiner at conventional intensity, for example, at a disc speed of 1200 RPM followed by low intensity treatment in the secondary refiner at a disc speed of 900 RPM, as shown in Fig. 9. No chip presteaming was used in this test.

[0043] In the production of thermomechanical pulp (TMP), it is common to separate underdeveloped fibres and fibre bundles after primary, secondary, or tertiary refining by screening or cleaning, for further refining in a rejects refiner. The pulp produced by the rejects refiner is of high quality because it contains a larger portion of long fibre than that produced by the mainline refiners. Material that was directed towards a reject refiner in a commercial mill was collected for controlled pilot plant experiments. As shown in Fig. 10, by refining employing a double disc refiner at lower intensity with a disc speed of 900 RPM, it was possible to put more energy into the pulp and achieve a higher burst value at a given tear than refining at conventional intensity employing a disc speed of 1200 RPM.

[0044] Further pilot plant experiments were conducted to demonstrate that the low intensity process of the invention also improves properties of pulp made from different wood species, particularly those that are underutilized because of relatively poor fibre properties. The pulp quality of jack pine produced at conventional refining intensity in a double disc refiner at a disc speed of 1200 RPM was compared to that produced with a low energy, low intensity pre-refining stage at 600 RPM followed by two stages of low intensity refining at 900 RPM. As shown in Fig. 11, low intensity refining may require more energy to reach a given freeness than refining at conventional intensity, however, at a given freeness, the burst index of the conventional jack pine pulp is lower than that produced with the low intensity process as shown in Fig. 12. The tear index of the low intensity jack pine pulp is greater than that produced at conventional intensity at freeness values below 200 ml CSF, which is in the range of commercial interest as shown in Fig. 13. The low intensity process produces a jack pine pulp with much greater tear and burst index than can be produced with refiners operating at conventional intensity as shown in Fig. 14.

[0045] In the production of chemimechanical pulp (CMP), the use of low intensity refining can also lead to enhanced properties. The results in Fig. 15 show that chips impregnated with a 140 g/l solution to give a 2 percent sulphonate content provide more tear at high burst levels using two stage, low intensity refining in a double disc refiner at 900 RPM than could be obtained by conventional refining at 1200 RPM. A similar plot is shown in Fig. 16, for a solution of 35 g/l and a sulphonate content of 0.9 percent. Low intensity refining results in much

higher tear strength, comparable to conventional refining at 2 percent sulphonate content.

[0046] Fig. 17 shows pulp properties achieved employing low intensity refining in two stages employing double disc refiners at 900 RPM in accordance with the invention, in comparison with the properties achieved employing a first low intensity stage at 900 RPM followed by a second high intensity stage at 1800 RPM as contemplated in U.S. Patent 5,540,392. The properties achieved with the method of the invention are markedly superior to those in the comparison and in particular the high intensity final stage of the comparison results in fibre damage which leads to loss of tear strength.

[0047] Variable refining intensity can provide improved quality control if the motor speed on at least the last refining stage is adjustable. For example, the schematic diagram in Fig. 18 combines secondary refiner speed control with on line measurement of freeness and fibre length. Thus, when freeness is too high motor load is increased by plate gap adjustment, while fibre length is maintained by reducing refining intensity by lowering the rotational speed according to this invention.

[0048] With further reference to Fig. 18, there is illustrated schematically a system 10 for refining wood chips with on-line quality control by feedback adjustment of refiner speed, i.e., refining intensity.

[0049] System 10 includes a first stage single disc refiner 12, a second stage single disc refiner 14, a motor speed controller 16 and a monitor 18 which monitors freeness and fibre length of product pulp.

[0050] A line 20 communicates monitor 18 with controller 16 and a line 22 communicates monitor 18 with a load or power control of secondary refiner 14.

[0051] System 10 additionally includes cyclones 24 and 26 and a latency chest 28.

[0052] Refiner 12 has a stationary disc 30 and a rotating disc 32 with a gap 34 therebetween and refiner 14 has a stationary disc 36 and a rotating disc 38 with a gap 40 therebetween.

[0053] In operation, aqueous wood chips are fed to gap 34 between disc 30 and 32 in refiner 12, refining takes place in gap 34 as disc 32 rotates, the resulting aqueous composition is fed from refiner 12 to cyclone 24 where an aqueous wood chip/pulp composition is separated from steam and fed to the gap 40 between discs 36 and 38 in refiner 14.

[0054] Further refining takes place in refiner 14 as disc 38 rotates and the resulting composition is fed to cyclone 26 where steam is separated from the pulp, the pulp from cyclone 26 is fed to latency chest 28, in conventional manner, where the pulp is agitated to straighten the fibres.

[0055] The resulting pulp is monitored for freeness and fibre length by monitor 18; in response to the fibre length monitored the speed of rotation of disc 38 may be altered by controller 16. If the fibre length monitored is too short the rotation of disc 38 is lowered by controller 16 to reduce the refining intensity. The load or power of

operation of refiner 14 may similarly be altered in conventional manner, in response to the freeness monitored by monitor 18.

[0056] Freeness and fiber length are given only as an example of the properties that can be controlled independently of each other. However, other measured on-line pulp properties such as specific surface and tear could also be used. The control scheme is given as an example of a scheme by which the invention is used to control two pulp properties by manipulation of rotational speed and specific energy.

Claims

1. A method for mechanical refining of a wood chip composition to produce wood pulp, in which the wood chip composition is subjected to a plurality of distinct sequential refining stages, in which energy is transferred to the wood chip composition under impact with rotating impact members, wherein said plurality of refining stages comprises at least two low intensity refining stages, each of said at least two low intensity refining stages being carried out in a refining apparatus selected from a double rotating disc refiner or a single rotating disc refiner such that, when said refining apparatus is a double rotating disc refiner, the rotating impact members thereof rotate at less than 1200 RPM, and, when said refining apparatus is a single rotating disc refiner, the rotating impact members thereof rotate at less than 1500 RPM, and wherein one of said at least two low intensity refining stages is the final refining stage.
2. A method according to claim 1, wherein said refining apparatus is a double rotating disc refiner, the rotating impact members of which rotate at not more than 1150 RPM.
3. A method according to claim 1, wherein said refining apparatus is a single rotating disc refiner, the rotating impact members of which rotate at not more than 1450 RPM.
4. A method according to any of the preceding claims, wherein said plurality of refining stages is 2.
5. A method according to any of claims 1 to 3, wherein said plurality of refining stages is at least 3.
6. A method according to claim 5, wherein said plurality of refining stages is 3, each of said refining stages being a low intensity refining stage.
7. A method according to claim 2, wherein the rotating impact members of said double rotating disc refiner rotate at 850 to 1000 RPM.

8. A method according to claim 7, wherein the rotating impact members of said double rotating disc refiner rotate at 900 RPM.
9. A method according to claim 3, wherein the rotating impact members of said single rotating disc refiner rotate at 1100 to 1300 RPM.
10. A method according to claim 9, wherein the rotating impact members of said single rotating disc refiner rotate at 1200 RPM.
11. A method according to any of the preceding claims, wherein said wood chip composition is a screen reject from a wood chip pulp of a main line refiner.
12. A method according to claim 1, wherein, prior to said plurality of refining stages, a pre-refining stage is carried out in a refining apparatus in which the rotating impact members rotate at less than 900 RPM.
13. A method according to claim 12, wherein said pre-refining stage is carried out in a refining apparatus in which the rotating impact members rotate at less than 600 RPM.

Patentansprüche

1. Verfahren zum mechanischen Raffinieren einer Holzspanzusammensetzung, um Holzpulpe herzustellen, in welchem die Holzspanzusammensetzung einer Mehrzahl von gesonderten, aufeinanderfolgenden Raffinierstufen unterworfen wird, in welchen Energie auf die Holzspanzusammensetzung unter Stoßen bzw. Schlagen mit rotierenden Preß- bzw. Stoßgliedern transferiert wird, wobei die Mehrzahl von Raffinierstufen wenigstens zwei Raffinierstufen niedriger Intensität umfaßt, wobei jede der wenigstens zwei Raffinierstufen niedriger Intensität in einer Raffiniervorrichtung ausgeführt wird, die aus einem Raffinierer mit doppelten, rotierenden Scheiben oder einem Raffinierer mit einer einzelnen rotierenden Scheibe derart ausgewählt wird, daß, wenn die Raffiniervorrichtung ein Raffinierer mit doppelten, rotierenden Scheiben ist, die rotierenden Stoßglieder derselben mit weniger als 1200 U/min rotieren, und wenn die Raffiniervorrichtung ein Raffinierer mit einer einzelnen rotierenden Scheibe ist, die rotierenden Stoßglieder davon mit weniger als 1500 U/min rotieren, und wobei eine der wenigstens zwei Raffinierstufen niedriger Intensität die Endraffinierstufe ist.
2. Verfahren nach Anspruch 1, wobei die Raffiniervorrichtung ein Raffinierer mit doppelten, rotierenden Scheiben ist, dessen rotierende Stoßglieder mit

nicht mehr als 1150 U/min rotieren.

3. Verfahren nach Anspruch 1, wobei die Raffiniervorrichtung ein Raffinierer mit einzelner rotierender Scheibe ist, dessen rotierende Stoßglieder mit nicht mehr als 1450 U/min rotieren.
4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Mehrzahl von Raffinierstufen 2 ist.
5. Verfahren nach einem der Ansprüche 1 bis 3, wobei die Mehrzahl von Raffinierstufen wenigstens 3 ist.
6. Verfahren nach Anspruch 5, wobei die Mehrzahl von Raffinierstufen 3 ist, wobei jede der Raffinierstufen eine Raffinierstufe niedriger Intensität ist.
7. Verfahren nach Anspruch 2, wobei die rotierenden Stoßglieder des Raffinierers mit doppelten rotierenden Scheiben mit 850 bis 1000 U/min rotieren.
8. Verfahren nach Anspruch 7, wobei die rotierenden Stoßglieder des Raffinierers mit doppelten rotierenden Scheiben mit 900 U/min rotieren.
9. Verfahren nach Anspruch 3, wobei die rotierenden Stoßglieder des Raffinierers mit einzelner rotierender Scheibe mit 1100 bis 1300 U/min rotieren.
10. Verfahren nach Anspruch 9, wobei die rotierenden Stoßglieder des Raffinierers mit einzelner, rotierender Scheibe mit 1200 U/min rotieren.
11. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Holzspanzusammensetzung ein Siebrückstand von einer Holzspanpulpe eines Hauptlinienraffinierers ist.
12. Verfahren nach Anspruch 1, wobei vor der Mehrzahl von Raffinierstufen eine Vorraffinierstufe in einer Raffiniervorrichtung ausgeführt wird, in welcher die rotierenden Stoßglieder mit weniger als 900 U/min rotieren.
13. Verfahren nach Anspruch 12, wobei die Vorraffinierstufe in einer Raffiniervorrichtung ausgeführt wird, in welcher die rotierenden Stoßglieder mit weniger als 600 U/min rotieren.

Revendications

1. Procédé de raffinage mécanique d'une composition de copeaux de bois pour produire de la pâte de bois, dans lequel la composition de copeaux de bois est soumise à une pluralité d'étages de raffinage successifs distincts, dans lequel une énergie est transférée à la composition de copeaux de bois par im-

- pact avec des éléments d'impact rotatifs, dans lequel la dite pluralité d'étages de raffinage comprend au moins deux étages de raffinage de faible intensité, chacun des dits au moins deux étages de raffinage de faible intensité étant effectué dans un appareil de raffinage choisi parmi un raffineur à double disque rotatif ou un raffineur à disque rotatif unique de sorte que, lorsque le dit appareil de raffinage est un raffineur à double disque rotatif, ses éléments d'impact rotatifs tournent à moins de 1200 tr/min et, lorsque le dit appareil de raffinage est un raffineur à disque rotatif unique, ses éléments d'impact rotatifs tournent à moins de 1500 tr/min, et dans lequel un des dits au moins deux étages de raffinage de faible intensité est l'étage de raffinage final.
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11. Procédé selon une quelconque des revendications
- précédentes, dans lequel la dite composition de copeaux de bois est un refus de tamis provenant d'une pâte de copeaux de bois d'un raffineur principal en ligne.
12. Procédé selon la revendication 1, dans lequel, avant la dite pluralité d'étages de raffinage, un étage de pré-raffinage est effectué dans un appareil de raffinage dans lequel les éléments d'impact rotatifs tournent à moins de 900 tr/min.
13. Procédé selon la revendication 12, dans lequel le dit étage de pré-raffinage est réalisé dans un appareil de raffinage dans lequel les éléments d'impact rotatifs tournent à moins de 600 tr/min.

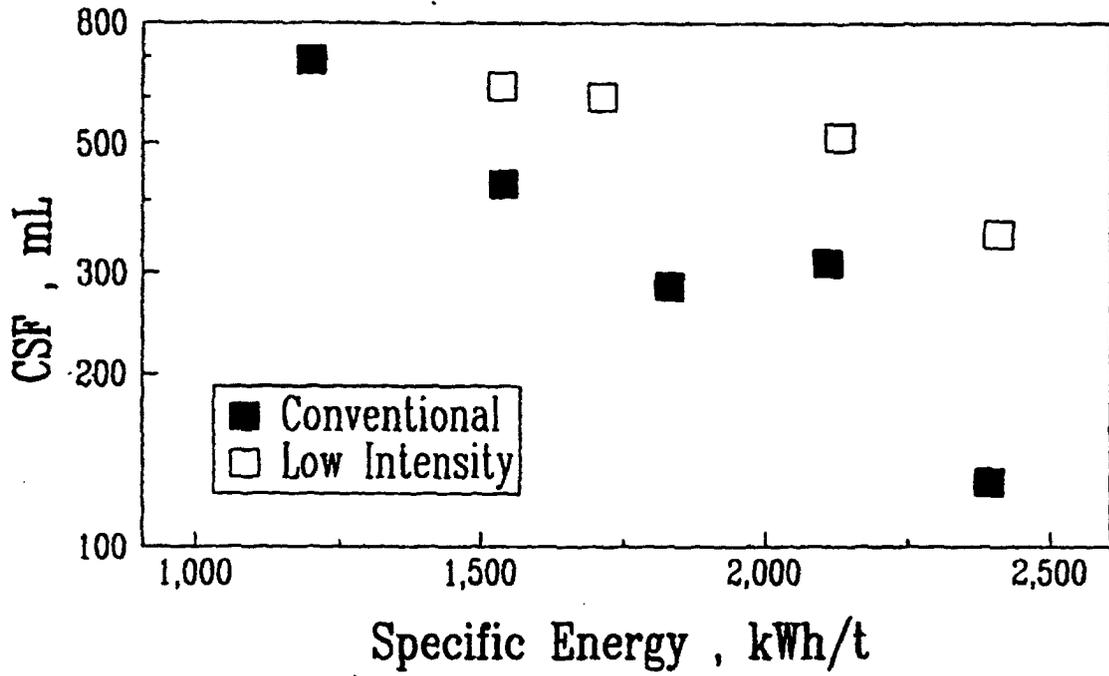


FIG. 1

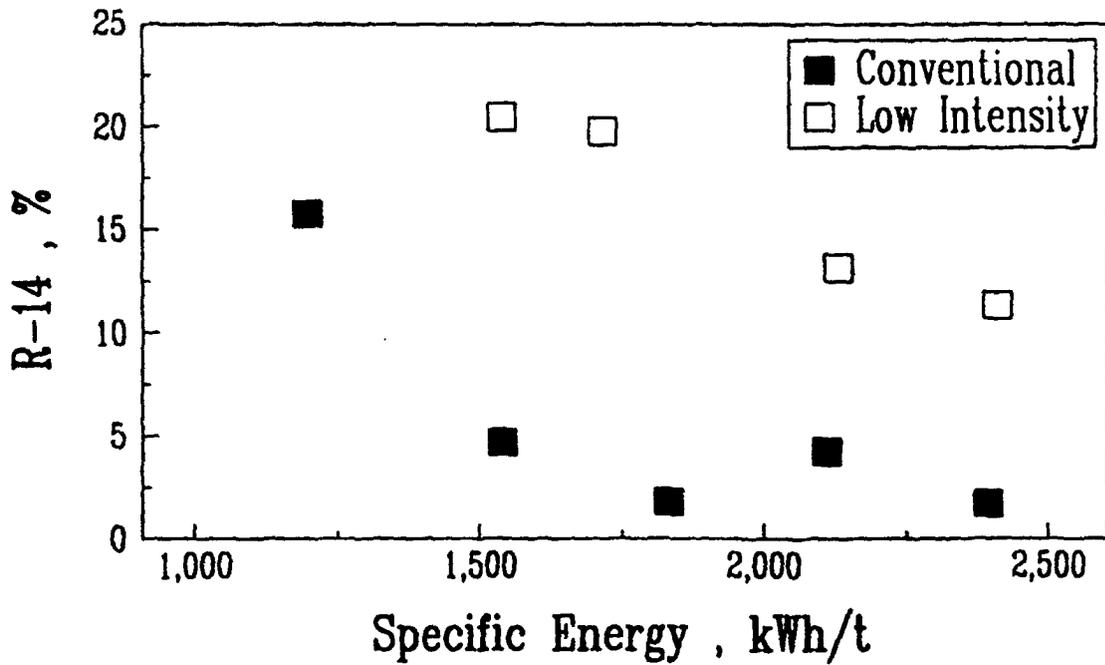


FIG. 2

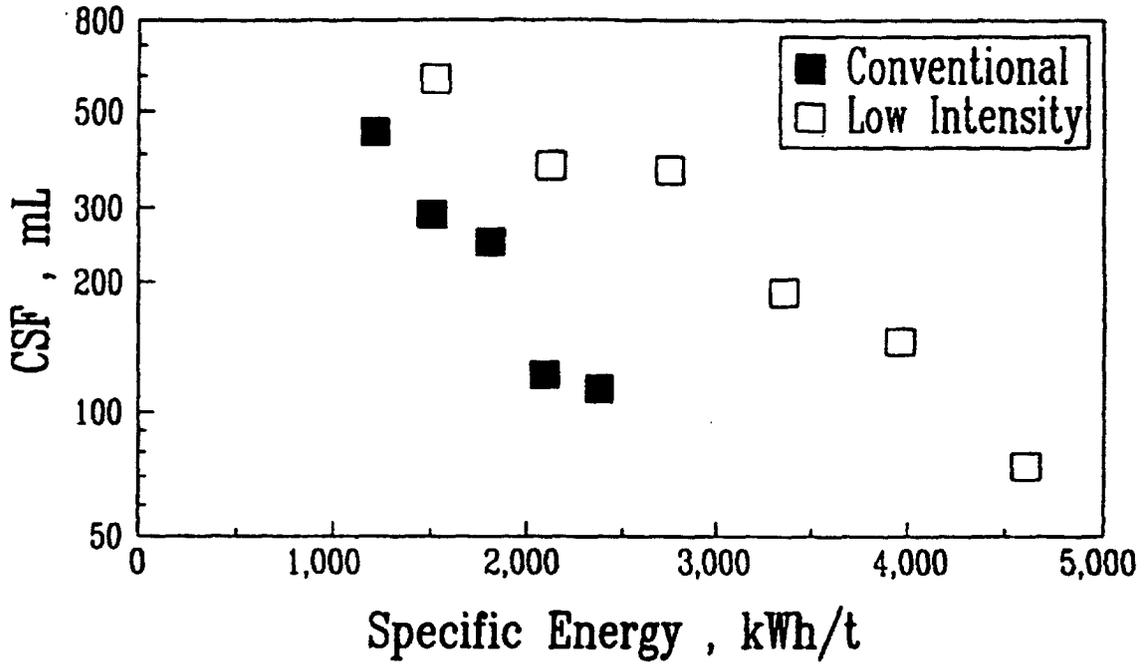


Fig. 3

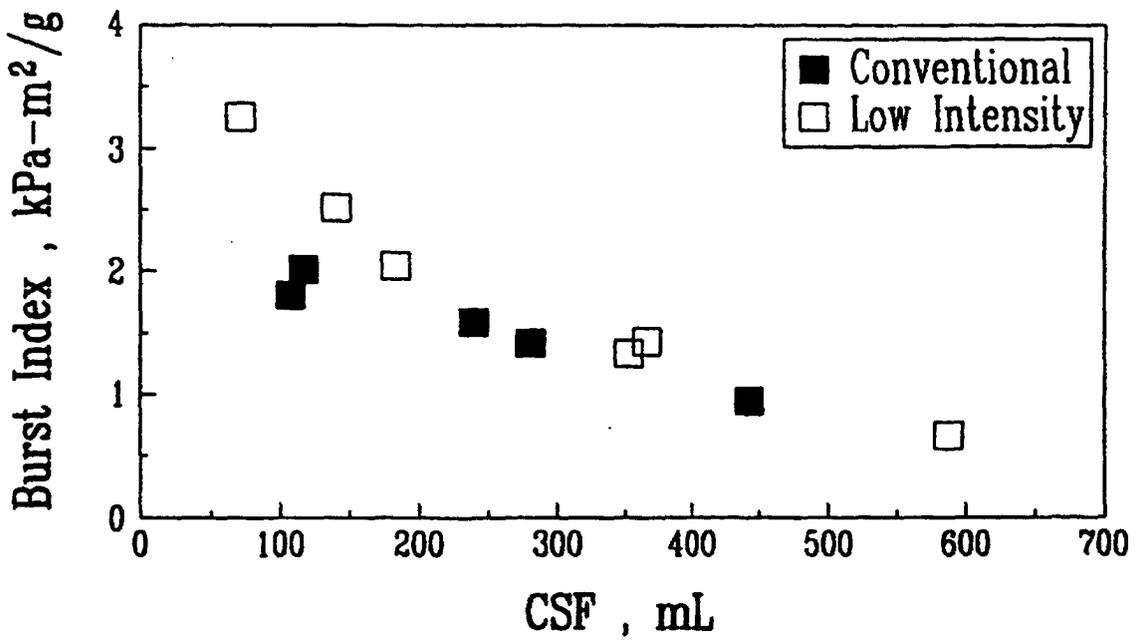


Fig. 4

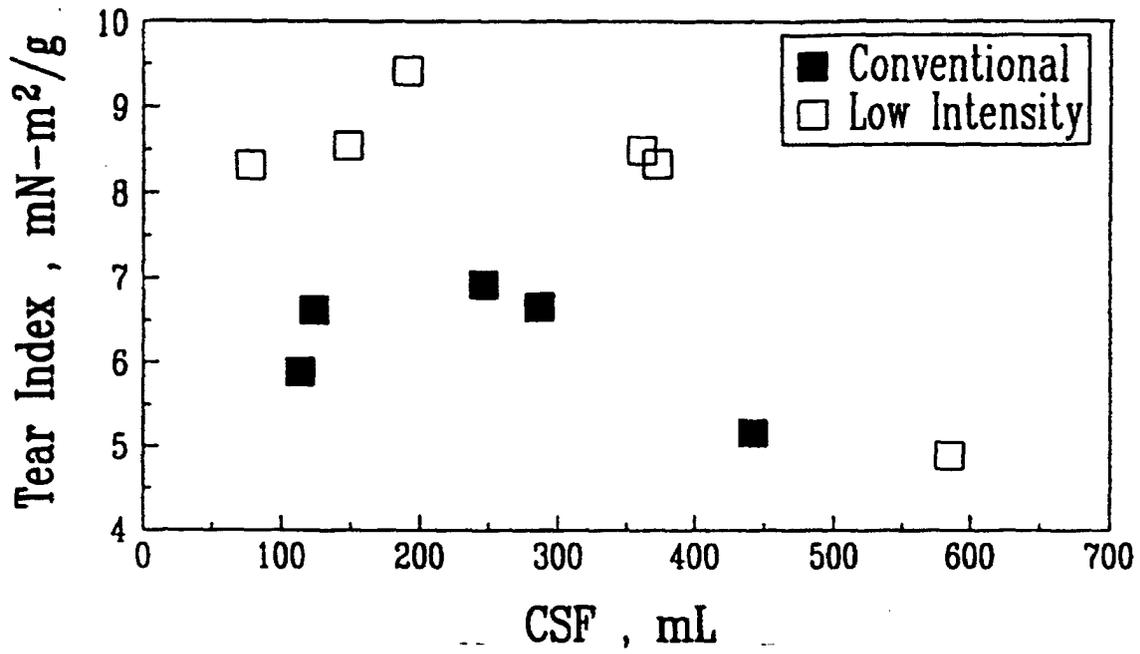


Fig. 5

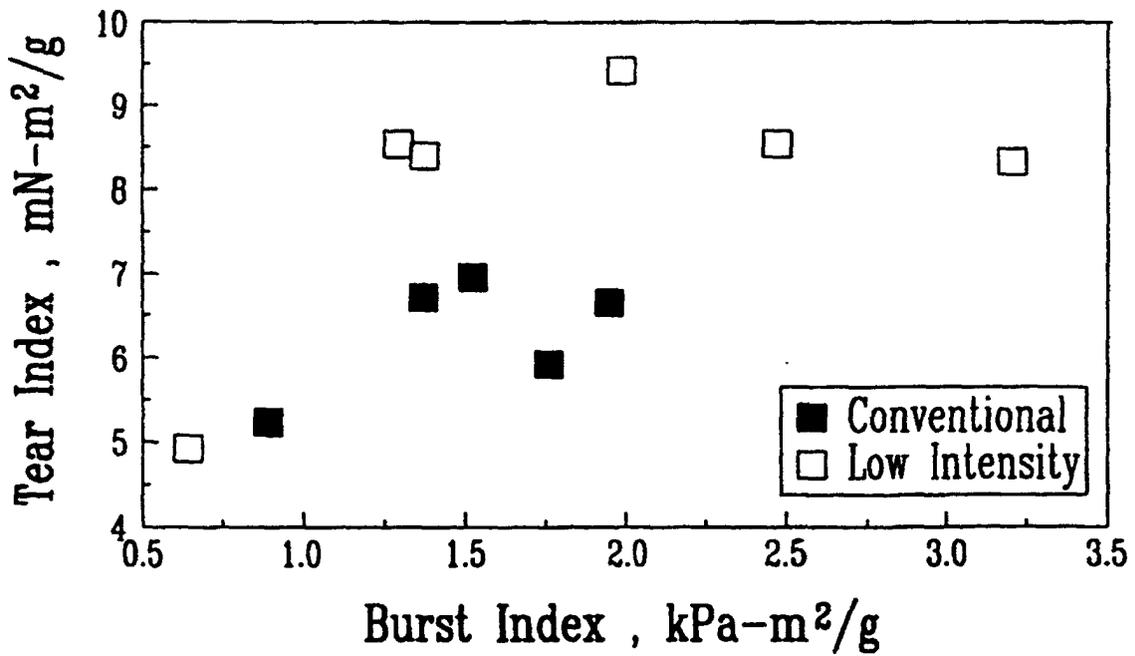


Fig. 6

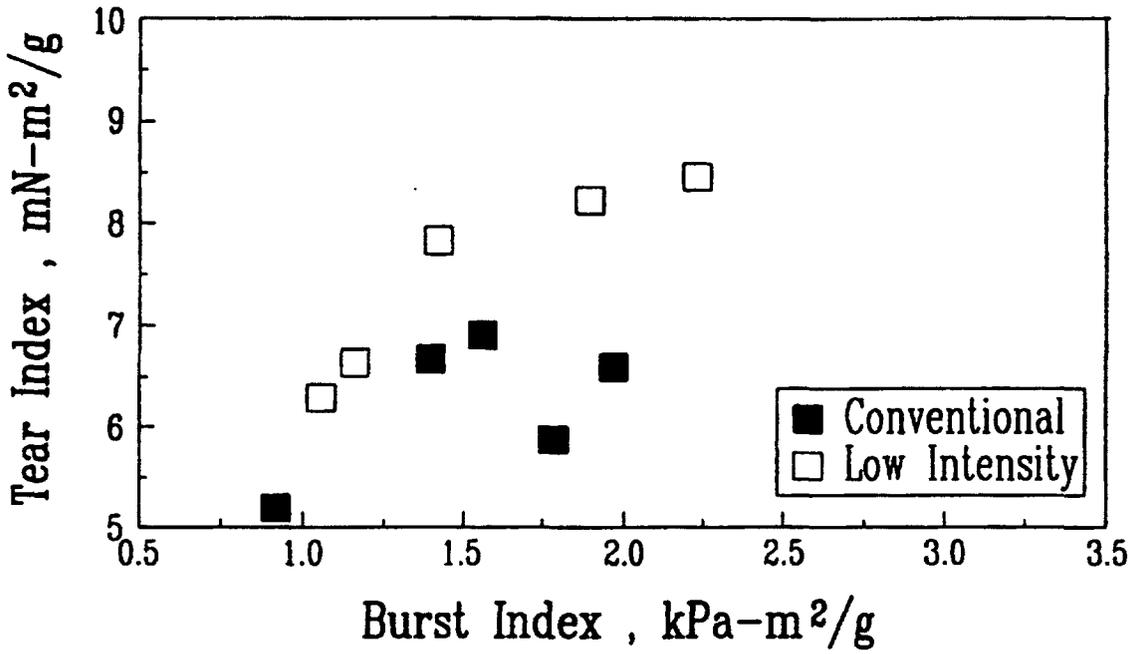


FIG. 7

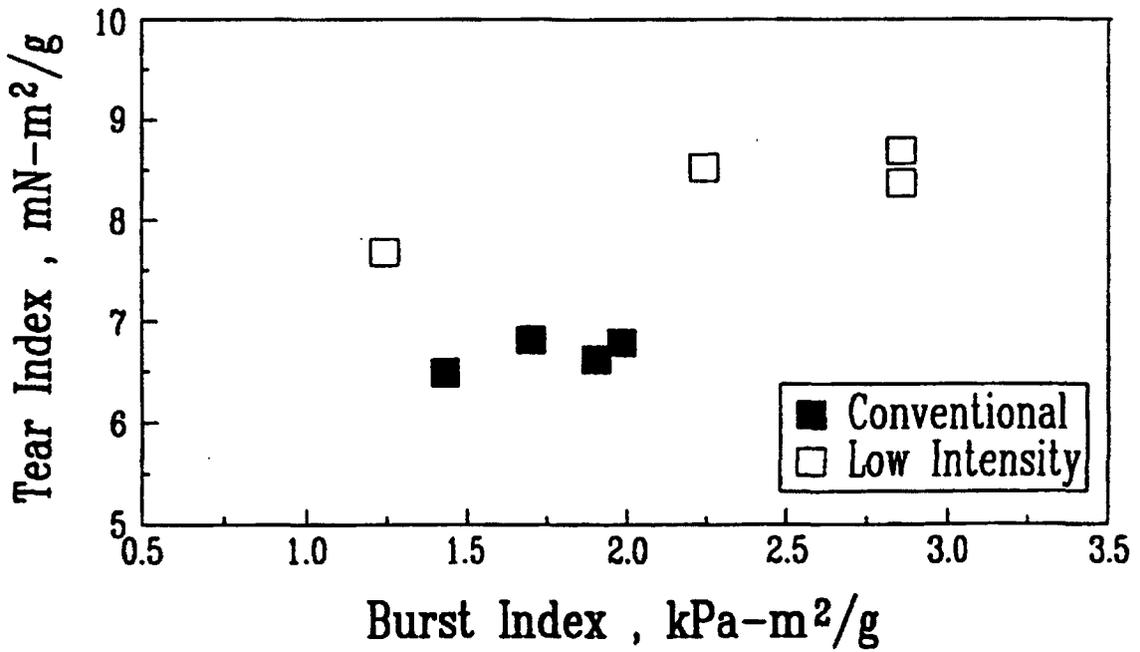


FIG. 8

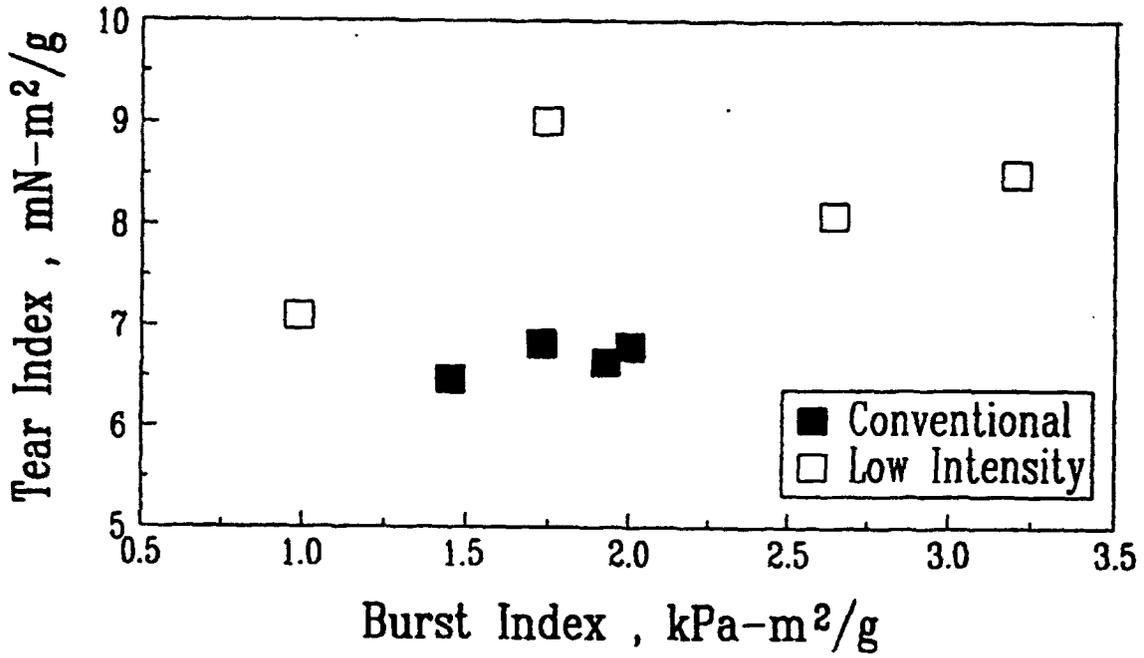


FIG. 9

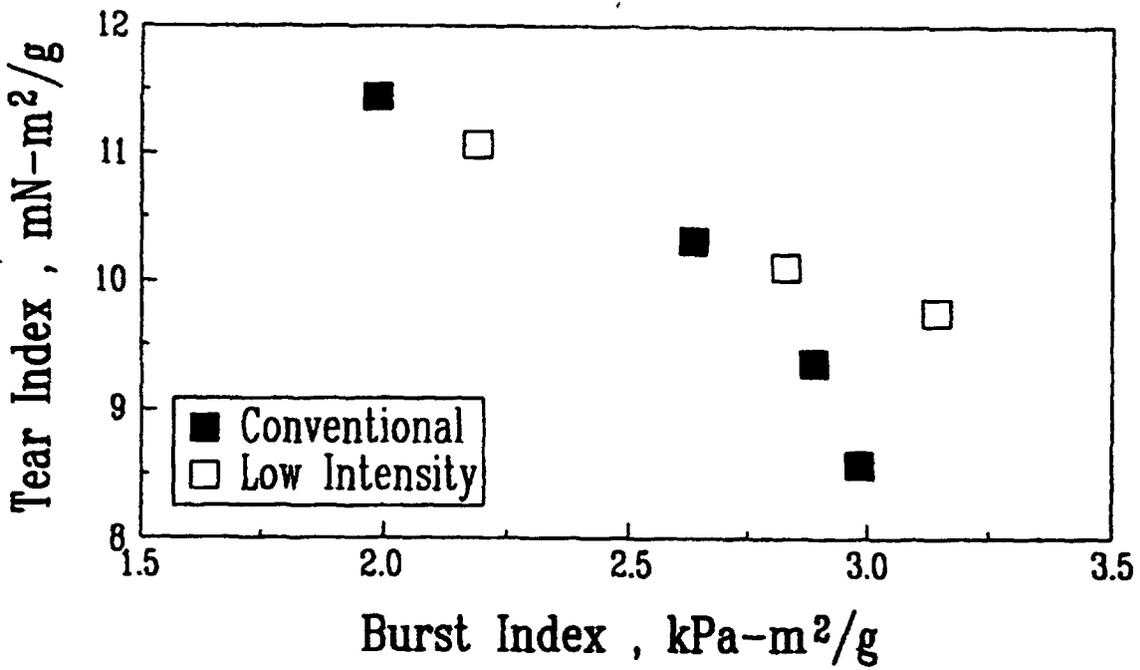


FIG. 10

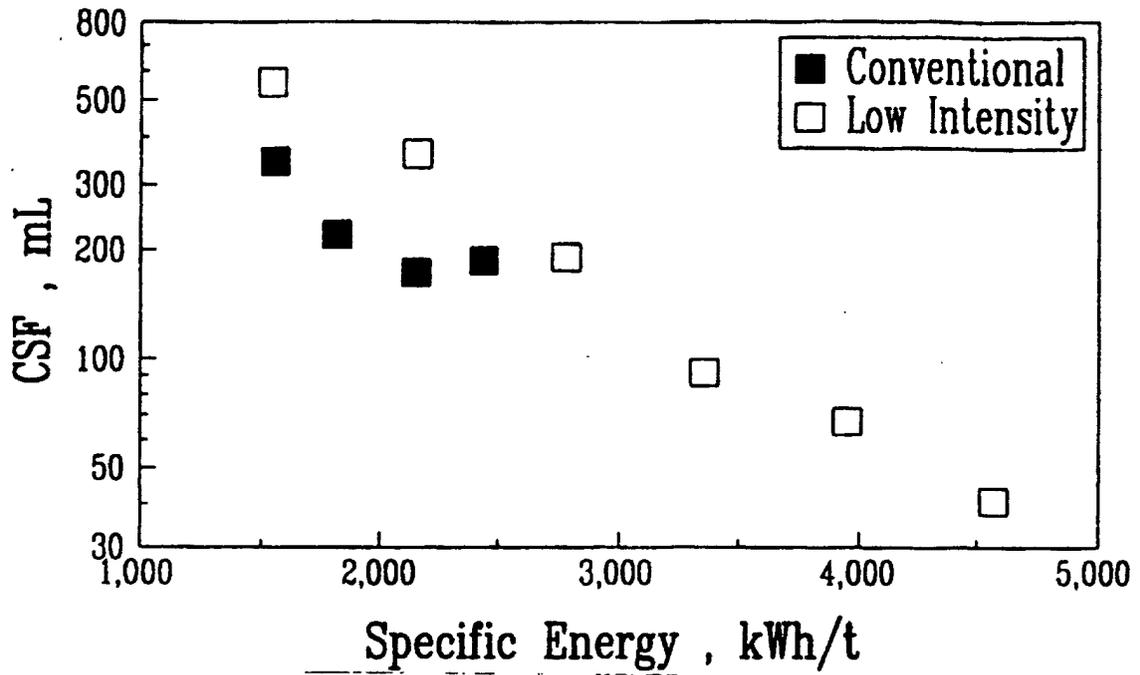


Figure 11

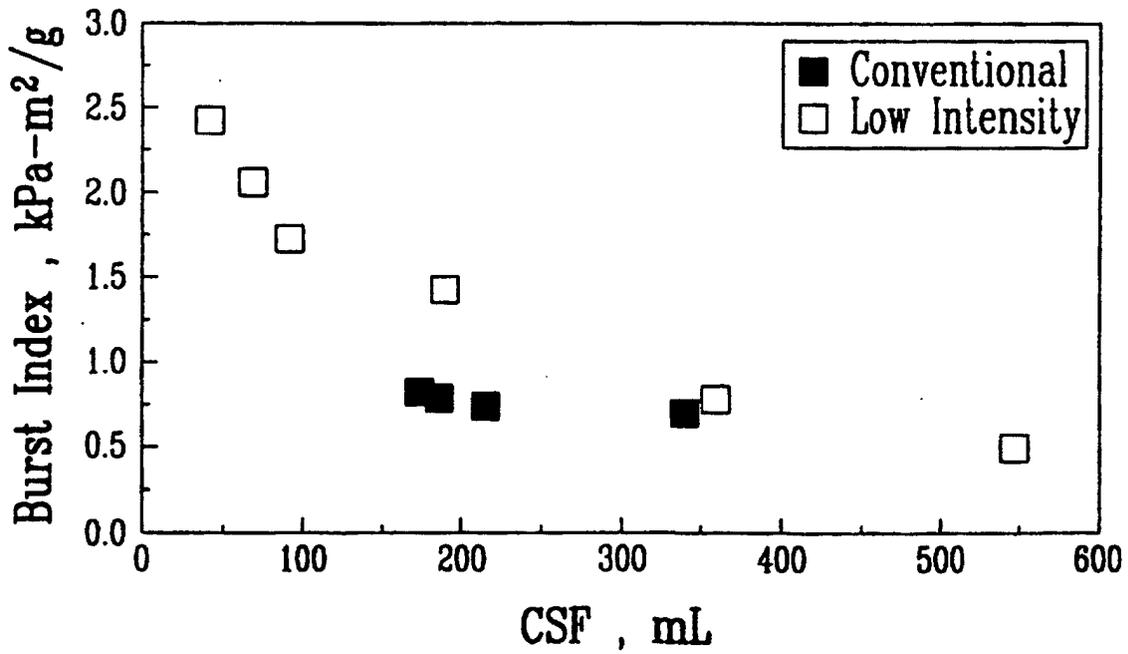


Figure 12

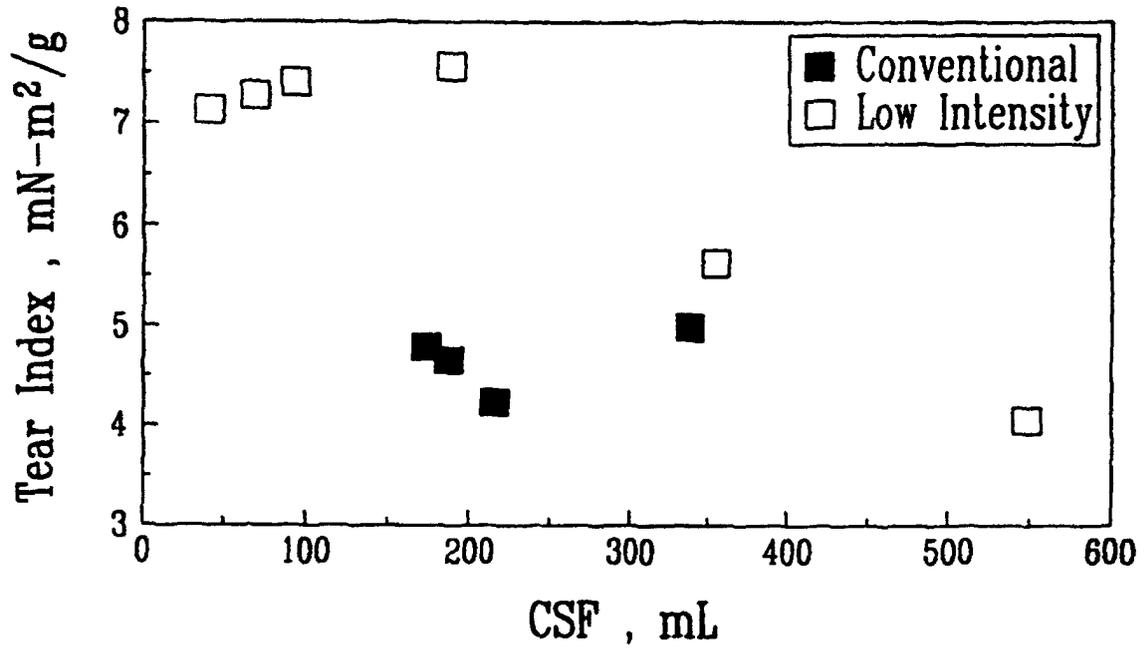


FIG. 13

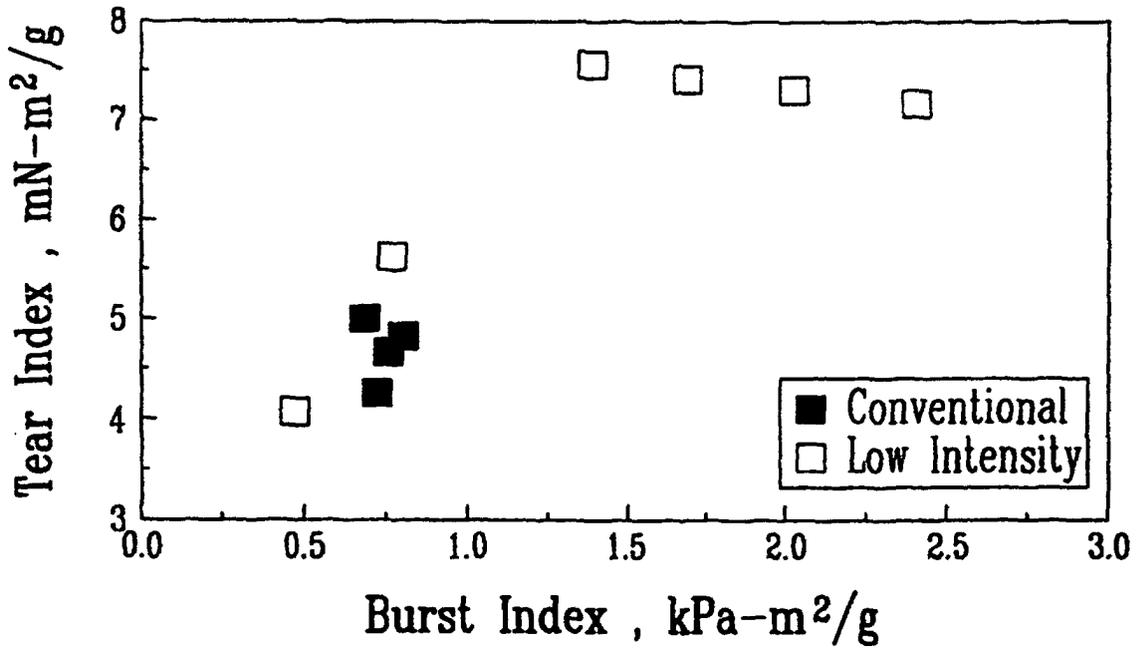


FIG. 14

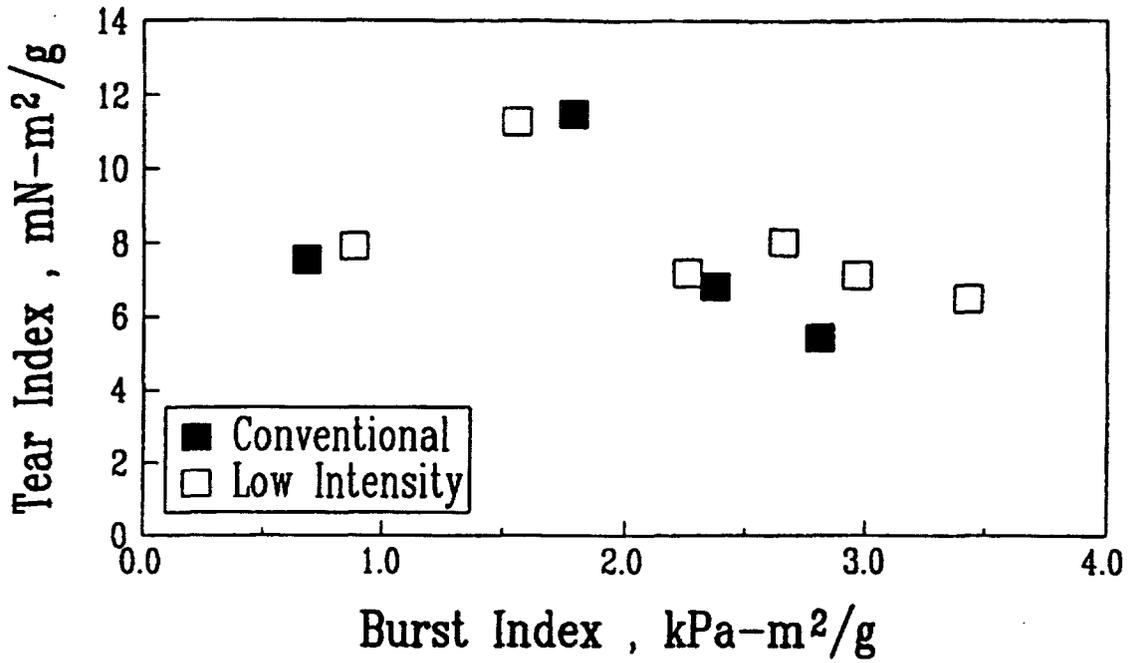


FIG. 15

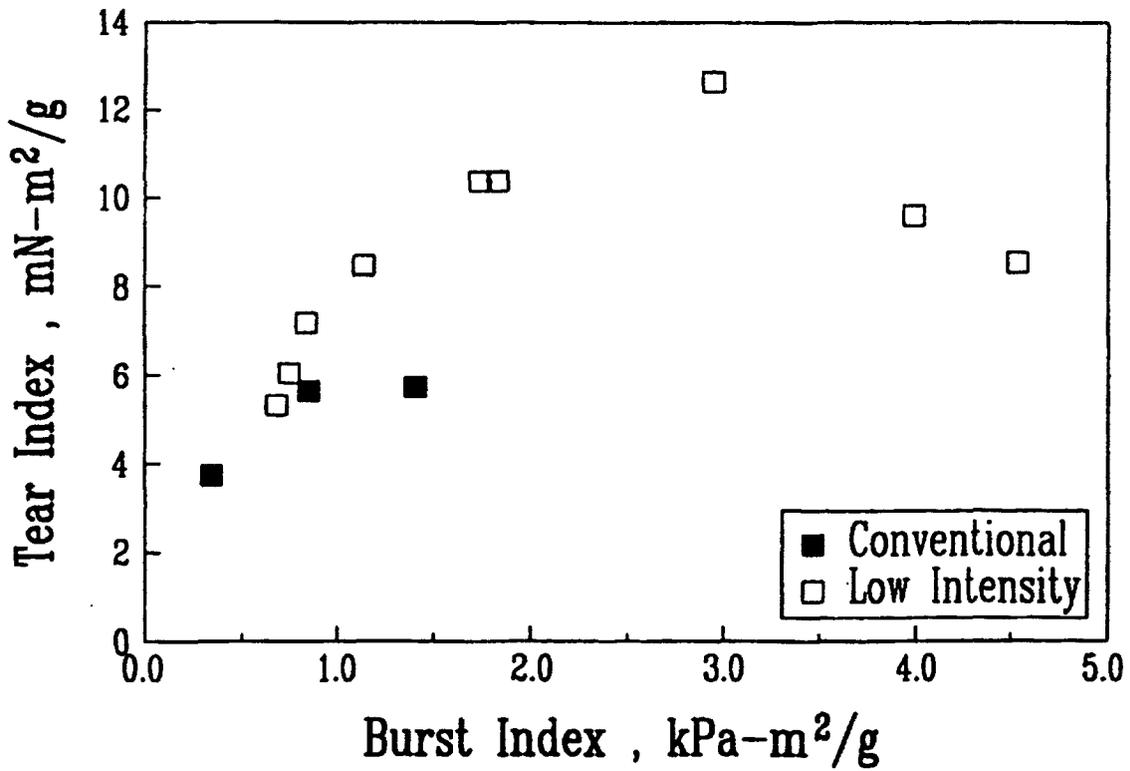


FIG. 16

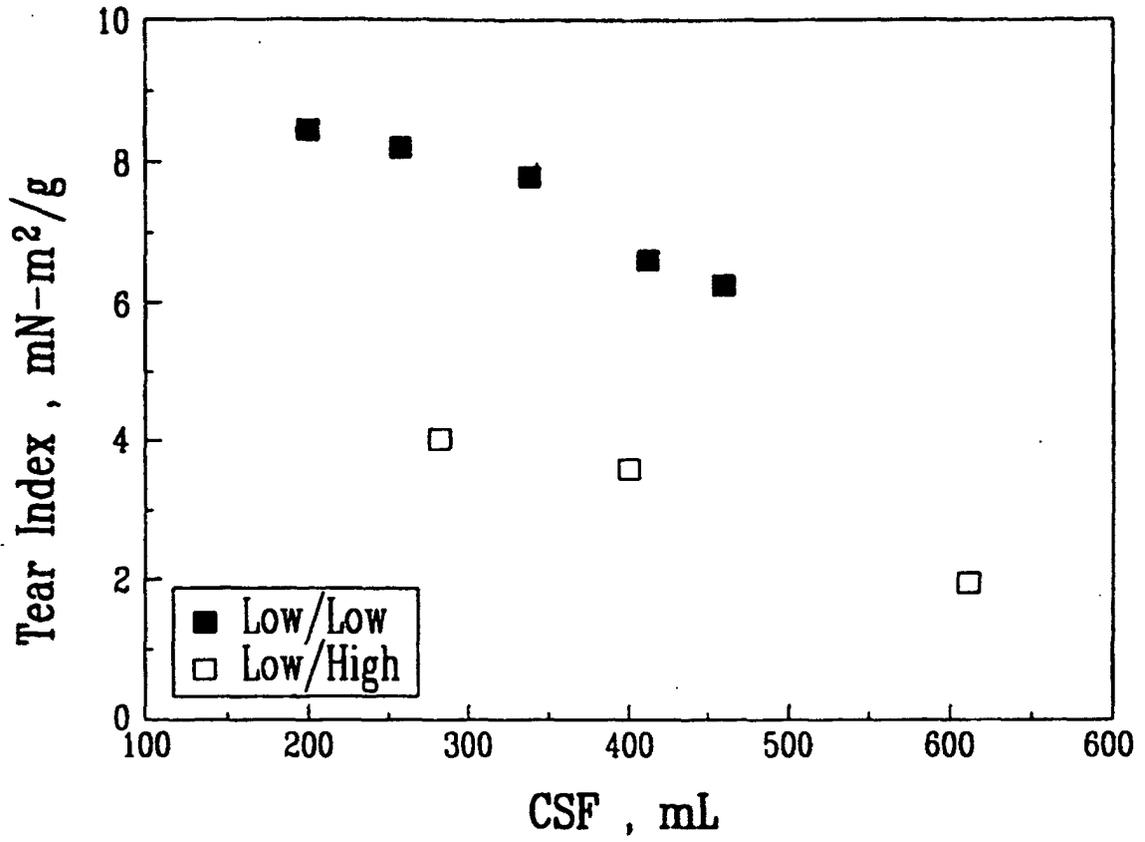


FIG. 17

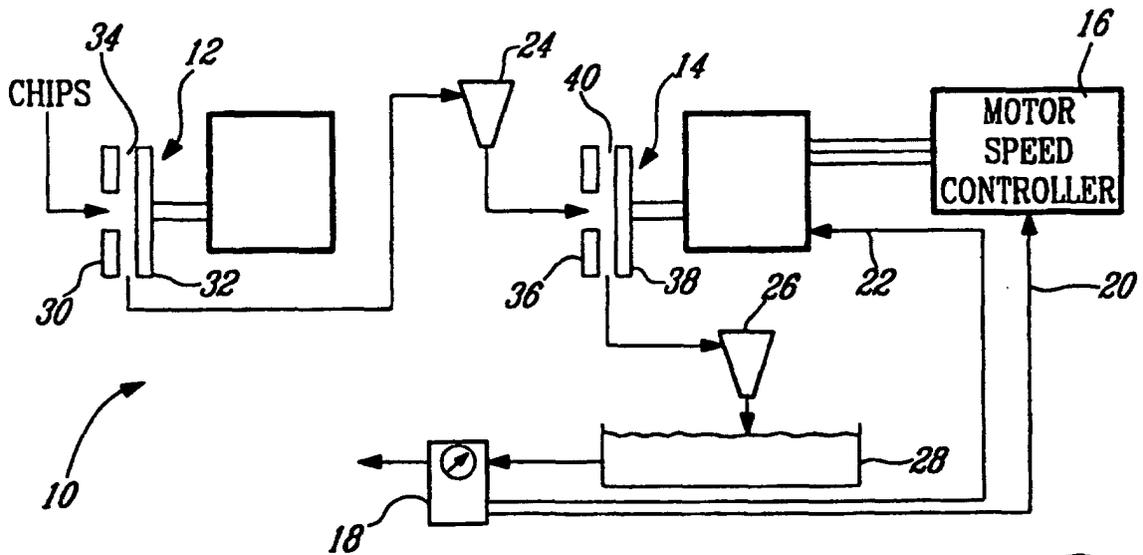


FIG. 18