Title: RECOVERY OF PLASTICS MATERIAL FROM OPTICAL STORAGE MEDIA

Abstract: A method and apparatus for the recovery of plastic material from a combination of at least one optical storage medium, such as a CD or DVD, formed at least in part from a first plastics material and at least one storage container adapted for holding said optical storage medium is provided; the storage container being formed at least in part from a second plastics material and at least one insert, label, wrapper or the like, the method comprising: providing said optical storage medium and said storage container in the form of granules and said insert, label, wrapper or the like in the form of pieces or the like; introducing said optical storage medium and said storage container in the form of granules and said insert, label, wrapper or the like in the form of pieces or the like into a gas stream to separate said granules from said pieces in said gas stream; and removing at least some of said pieces from said gas stream. In a second stage the first and second plastics are separated from each other by using a liquid having a particular specific gravity such that one type of plastic floats and the other type of plastic sinks.
"RECOVERY OF PLASTICS MATERIAL FROM OPTICAL STORAGE MEDIA"

TECHNICAL FIELD

The present invention relates to a method and apparatus for separation and recovery or reclamation of plastics material and in particular to an apparatus and method for separation and recovery of the components making up optical storage media products and plastic storage containers for such products.

BACKGROUND

Disk recording media, such as optical disks, have become the storage media of choice for recording music, images, information and software because of their capability of high-density recording. In particular, compact disks (CDs) and other optical disks in the CD family have been used on a large scale.

Generally a CD includes a polycarbonate substrate, an aluminium reflective film, and a protective layer deposited in that order.

Although CDs are not particularly fragile, they can be rendered unusable if the surface of the disc is scratched or marred, or a disc is otherwise chipped, cracked or broken. In order to prevent damage, it is important that a storage case be provided that will protect the disc during transportation to the consumer, and while in the possession of the consumer.

Several known compact disc storage cases exist, including the ones shown in Herr, et al., U.S. Pat. No. 5,445,265; and Philosophe, U.S. Pat. No. 4,702,369. Currently the most popular type of storage case for use with an audio-containing compact disc is the so-called "jewel case" which comprises a cover member and a base member, both of which are commonly made from styrene (polystyrene). The cover and base are formed as two separate members, and are hingedly coupled together.

These storage containers generally include an insert or label upon which is printed information and/or images relating to the contents of the CD. Generally the insert or label is a sheet-like material made of paper or the like.

Optical storage media such as CDs have become so ubiquitous that they now present a disposal problem. On the other hand waste optical media also present a potentially valuable resource in terms of the plastic material from
which they are formed, and in the case of some forms of optical media (eg DVDs and writeable and rewriteable CDs), the precious metal reflective layer.

Apart from the waste issue, there is also need for secure destruction of optical storage media storing sensitive information to prevent unauthorised access and/or copying of the information. This information may be confidential information or it may be copyright information or both.

Various methods have been proposed to reclaim potentially valuable material from optical storage media. These involve chemical, mechanical or a combination of mechanical and chemical treatments. In many cases, chemical solutions to the problem simply replace the waste problem caused by the optical recording media with a waste disposal problem in terms of the disposal of spent chemicals.

As far as we are aware, none of the solutions proposed thus far provide means that result in the reclamation of material not only from the optical recording medium itself, but also from the plastic container used to house the optical storage medium.

We have devised a method that allows for the recovery of plastic material from the optical storage medium itself as well as plastic material from the storage container, which method does not necessarily require the optical storage medium to be physically separated from its container prior to the recovery of the plastics material.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

**SUMMARY OF THE INVENTION**

Accordingly, in a first aspect, the present invention provides a method for the recovery of plastic material from a combination of:

(a) at least one optical storage medium formed at least in part from a first plastics material;

(b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and
(c) at least one insert, label, wrapper or the like, the method comprising:
   (i) providing said optical storage medium and said storage container in
        the form of granules and said insert, label, wrapper or the like in the form of
        pieces or the like;
   (ii) introducing (i) into a gas stream to separate said granules from said
        pieces in said gas stream; and
   (iii) removing at least some of said pieces from said gas stream.

The "at least one insert, label, wrapper or the like" to which reference is
herein made may be formed from any material conventionally used in optical
disk labels, insert or packaging. The insert, label and/or wrapper may in the
form of a sheet or a film. For example, the material may be paper sheet and/or
plastic film.

The storage container may be a jewel case conventionally used to store
CDs and the like, although it will be clear that the method of the present
invention has application to any storage container formed from at least one
plastics material.

Step (i) may be carried out at the same location as steps (ii) and (iii) or
step (i) may be carried out at a remote location and transported to the site at
which steps (ii) and (iii) are performed.

Accordingly, in a second aspect, the present invention provides a
method for the recovery of plastic material from the combination of:
   (a) at least one optical storage medium formed at least in part from a
        first plastics material;
   (b) at least one storage container adapted for holding said optical
        storage medium, the storage container being formed at least in part from a
        second plastics material; and
   (c) at least one insert, label or the like, the method comprising:
       (i) subjecting said optical storage medium, said storage container and
        said insert, label or the like to granulation to produce a granulated product
        comprising plastic granules and pieces of said insert, label or the like;
       (ii) introducing said granulated product into a gas stream to separate
        said granules from said pieces in said gas stream; and
       (iii) removing at least some of said pieces from said gas stream.

Steps (ii) and (iii) may be repeated, preferably until substantially all the
pieces are removed.
The size of the granulated plastic material is preferably in the range of about 8 to 10 mm.

The first and second plastics material may be the same or different. The first plastics material may be a polycarbonate, which is conventionally used in optical disks, and the second plastics material may be a styrene polymer or copolymer and/or a ABS copolymer (acrylonitrile-butadiene-styrene) which is conventionally used in jewel cases. Conventionally optical disk storage containers comprise three types of plastics - polystyrene, high impact polystyrene with a minor proportion of ABS.


The gas stream may be an air stream.

We have further found that it is possible to separate a first plastics material from a second plastics material by submerging the two plastics materials in granulated form in a solution having a preselected specific gravity (SG).

Accordingly, the present invention provides, in a third aspect, a method for the recovery of plastics material from one or more material(s) containing at least two different plastics, the method comprising the steps of:

- granulating said one or more materials to produce granules of each of the different plastics materials; and
- submerging said granulated material in a liquid having a specific gravity equal to or falling between the specific gravity of one plastics material and selectively recovering one of the plastics materials.

The first plastics material may be an optical storage medium and the second plastics material may be a container therefor. The plastics may be laminated and the method may include a preliminary treatment to separate said laminate layers.

In fourth and fifth aspects, the present invention provides a method in accordance with the first and second aspect respectively including as a further step, the method of the third aspect.

Accordingly, in another aspect, the present invention provides a method for the recovery of plastic material from a combination of:

(a) at least one optical storage medium formed at least in part from a first plastics material;
(b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and

c) at least one insert, label, wrapper or the like, the method comprising:

(i) providing said optical storage medium and said storage container in the form of granules and said insert, label, wrapper or the like in the form of pieces or the like;

(ii) introducing (i) into a gas stream to separate said granules from said pieces in said gas stream; and

(iii) removing at least some of said pieces from said gas stream;

wherein the method further comprises submerging said separated granules in a liquid having a specific gravity equal to or falling between the specific gravity of one of said first and second plastics material and selectively recovering one of said plastics materials.

In another aspect, the present invention provides a method for the recovery of plastic material from the combination of:

(a) at least one optical storage medium formed at least in part from a first plastics material;

(b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and

(c) at least one insert, label or the like, the method comprising:

(i) subjecting said optical storage medium, said storage container and said insert, label or the like to granulation to produce a granulated product comprising plastic granules and pieces of said insert, label or the like;

(ii) introducing said granulated product into a gas stream to separate said plastic granules from said pieces in said gas stream; and

(iii) removing at least some of said pieces from said gas stream;

wherein the method further comprises submerging said separated granulated product in a liquid having a specific gravity equal to or falling between the specific gravity of one of said first and second plastics material and selectively recovering one of said plastics materials.

The liquid used in the method of the foregoing aspects of the invention may be a solution. The solution used may be a salt solution. The salt may be sodium chloride. An advantage of using sodium chloride is that a conventional
dechlorinator (eg a swimming pool dechlorinator) may be used to treat the saline solution prior to disposing it to waste.

The solution may be contained in a settling tank or the like.

The SG of the solution may fall in the range 1.02 to 1.2. The SG may be about 1.02.

The plastic material of the optical recording medium will usually comprise a metal film, which may be aluminium or a more valuable metal such as gold. This metal film may be removed by subjecting granules of the first plastic to a metal recovery step. The optical recording medium may have printing thereon which may also be removed.

Accordingly, the present invention provides in further aspects respectively, a method of the fourth or fifth aspects, which further comprises a step in which at least a portion of metal associated with the separated granules of the first plastics material is recovered. The methods and apparatus of the invention extend to recovery of metals in addition to recovery of plastics.

The metal may be recovered by subjecting the separated first plastics material to wet mechanical agitation.

Preferably the wet mechanical agitation is carried out in the presence of a granular abrasive material, eg sand, to assist in the removal of printing from the surface of the granules.

The wet mechanical agitation may be performed in a hammer mill or the like.

In a further aspect, the present invention provides any plastics material and/or metal recovered by a method in accordance with the present invention.

A particular advantage of the present invention is that it avoids the use of chemicals (apart from salt) in the process and so avoids the production of chemical waste that must be disposed of.

In a further aspect, the present invention provides an apparatus for the recovery of plastic material from the combination of:

(a) at least one optical storage medium formed at least in part from a first plastics material;

(b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and

(c) at least one insert, label or wrapper, the apparatus comprising:
(i) granulation means for granulating said first and second plastics material and for forming pieces of said paper or the like;

(ii) at least one column provided with a means for providing a flow of gas and means for removal of paper from the column; and

(iii) a settling tank or the like containing a liquid of preselected specific gravity.

Preferably the granulation means has a set of knives or the like on a rotary stator. An example of a suitable granulator is an Olmar granulator. Preferably the granulator is equipped with a vacuum chamber below the rotary knives to prevent the paper from clogging up the screen of the granulator.

Preferably, the flow of air through the at least one column is controllable by means of a valve. Preferably the apparatus of the present invention is equipped with a plurality of columns, each of the columns communicating at or adjacent their base with an adjacent column to allow granulated plastics material to pass therebetween. Each column may be provided with an opening adjacent the top of the column to allow paper to be blown out of the column into a collection point.

The means for providing a flow of air may be at least one fan, blower or compressor or it each column may have an associated fan or blower.

In one particularly preferred embodiment, a single blower provides a flow of air in each column, with the flow of air being controlled by means of a valve. An alternative to using valves is to control air flow by using columns of different diameters. For example, a 100 mm diameter pipe could be used for the first column and pipes of diameter of about 300mm could be used for the other pipes. A combination of metering valves and column diameters may be employed.

In a further aspect, the present invention provides a settling tank, the settling tank having a sloping floor, the settling tank including skimmer means for skimming off granular material floating on a liquid contained in the settling tank and screw conveyer means or the like for conveying granular material from the floor of the tank to a location above the floor of the tank.

The skimmer means may be a set of paddles or the like connected by a set of mechanically driven circular chains to provide continual skimming of the liquid surface.
Whilst the present invention has been described with particular reference to optical recording media, it also has application in the treatment of other material(s), provided those materials can be granulated.

In order that the present invention may be more readily understood, we provide the following non-limiting embodiments

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a block diagram showing the various stages of an embodiment of a method in accordance with the invention;

Figure 2 is a detailed schematic drawing of an embodiment of the granulation/paper separation stage of Figure 1;

Figure 3 is a detailed schematic drawing of an embodiment of the plastics separation stage of Figure 1;

Figure 4 is a detailed schematic drawing of the separation vessel; and

Figure 5 is a detailed schematic drawing of the metal recovery section of the apparatus in accordance with the invention.

**Embodiments**

This particular embodiment is described with particular reference to the reclamation of plastics from CDs contained in jewel cases containing paper labelling/inserts.

Referring to Figure 1, the CDs/jewel cases/paper inserts are subjected to a "plastic granulation/paper separation" stage 10. The plastic granules, substantially free of paper, are passed to a plastics separation stage 20 in which granules of the plastic material forming the CD (polycarbonate) are separated from granules of plastic forming the jewel case (polystyrene/ABS). The polycarbonate granules are transferred to a metal separation stage 30 in which metal and printing are separated from the polycarbonate granules.

Figure 2, shows the plastic granulation/paper separation stage shown in Figure 1. In this stage, CDs, their jewel cases and paper labelling/inserts are fed into granulator 50. Granulator 50 granulates the plastic content of the CDs and cases and tears/shreds the paper inserts/labelling into pieces.

In this particular embodiment use was made of an Olmore granulator having rotary knives supported on a rotor. The granulator was modified to include a vacuum chamber 52. An air blower 70, connected to the vacuum chamber by means of pipe 56, reduces the pressure in vacuum chamber 52
whilst transferring plastic granules/paper pieces produced in the granulator to vertical pipe 60, the first of a series of vertical pipes. Application of a vacuum to the vacuum chamber prevents paper pieces from collecting on the screen of the granulator. We have found that this arrangement allows processing of input material containing up to about 60% paper.

The paper pieces are removed from the plastic granules in a series of vertical pipes 60 to 68 which have an opening 80 feeding into an air pervious collector 85. The first pipe 60 has a diameter of 100 mm, whereas the remaining pipes 62-68 have each have a larger diameter of 300mm.

Each vertical pipe communicates with an adjacent vertical pipe via a blower (72, 74, 76, 78) and pipe (73). As can be seen from Figure 2, each vertical pipe is in fluid communication with an upstream blower and a downstream blower. For example, first vertical pipe 60 is in fluid communication with upstream blower 70 and downstream blower 72. Each upstream blower provides a positive airflow to produce an airstream in the associated downstream vertical pipe. The air speed of this airstream is adjusted by means of metering valve 77, which controls the negative airflow created by the associated downstream blower. The air speed in each vertical pipe is adjusted so that only the paper pieces are entrained in the air stream and transferred to paper collector 85, whilst the plastic granules fall to the bottom of the vertical pipe. The plastic granules freed with reduces paper content are transferred to the adjacent downstream vertical pipe by means of the associated downstream blower. In this arrangement the amount of paper removed decreases progressively from the first vertical pipe to the last pipe, with most paper being removed from the first pipe and very little being removed from the last pipe.

The plastics separation section is shown in Figure 3. Plastic granules leaving the last vertical pipe 68 contain little or no paper contamination. These granules are transferred to distributor 101 by means of air flow created by blower 80. Distributor 101 is in the form of a cyclone which removes entrained air from the granulated product. The air-free granules are gravity fed to a mixing vessel or bowl 103, which is located against a side of settling tank 200. Tank 200 contains a saline solution of SG 1.02. The mixing bowl 103 is in fluid communication with the interior of the separation vessel and permits saline solution on one side of a partition (not shown) to pass into the mixing bowl and mix with the plastic granules.
The mixture of plastic granules and saline is pumped by pump 123 into the settling tank via conduit 125. The SG of polystyrene is about 1.05 and that of polycarbonate is about 1.2. The polystyrene granules, being less dense than the saline solution, float to the top of the solution whilst the denser polycarbonate granules sink to the bottom of the tank.

The polystyrene granules floating on the saline solution are "grabbed" by a series of paddles 127 supported on a pair of driven circular chains 130 and moved towards outlet 140 after being sprayed with fresh water from sprayer 139 (see Figure 4). The rinsed polystyrene granules are transferred to a dryer 143 where they are dried and thereafter the dried granules are transferred to bulk storage container 145.

The denser polycarbonate granules settle on the sloping floor 160 of the settling tank and move towards well 162. The polycarbonate granules are raised by screw conveyer 164 to the top of the settling tank and the wet granules are transferred to the metal removal section as shown in Figure 4. At least some of the polycarbonate granules have thin film of a metal such as aluminium. Some of granules also have printing which has to be removed.

The wet polycarbonate is metered into a water/sand mixture contained in vessel 300 enclosing hammermill 302. The action of the hammermill removes the metal film while the sand assists in abrading the printing from the polycarbonate granules. Polycarbonate granules free of metal film and printing are removed from vessel 300 and transferred to storage container 306.

A portion of the water/sand mixture containing metal film and printing residue is pumped by pump 309 via conduit 308 to water cyclone 320, which separates out wet sand at the base of the cyclone (see Figure 5). The water/sand mixture is returned to vessel 300 by means of pump 322 via conduit 324. The metal film and printing removed by the treatment in vessel 300 floats to the top of the water cyclone and passes into collecting vessel 324 where the metal and printing are retained. Water is removed from vessel 324 and transferred to vessel 326. Water from vessel 326 is recycled by pump 328 to vessel 300 via conduit 400.

The polycarbonate and polystyrene recovered by the method described may be recycled.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not
the exclusion of any other element, integer or step, or group of elements, integers or steps.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.
CLAIMS:

1. A method for the recovery of plastic material from a combination of:
   (a) at least one optical storage medium formed at least in part from a
   first plastics material;
   (b) at least one storage container adapted for holding said optical
       storage medium, the storage container being formed at least in part from a
       second plastics material; and
   (c) at least one insert, label, wrapper or the like, the method
   comprising:
      (i) providing said optical storage medium and said storage container in
          the form of granules and said insert, label, wrapper or the like in the form of
          pieces or the like;
      (ii) introducing (i) into a gas stream to separate said granules from said
           pieces in said gas stream; and
      (iii) removing at least some of said pieces from said gas stream.

2. A method for the recovery of plastic material from the combination of:
   (a) at least one optical storage medium formed at least in part from a
   first plastics material;
   (b) at least one storage container adapted for holding said optical
       storage medium, the storage container being formed at least in part from a
       second plastics material; and
   (c) at least one insert, label or the like, the method comprising:
      (i) subjecting said optical storage medium, said storage container and
          said insert, label or the like to granulation to produce a granulated product
          comprising plastic granules and pieces of said insert, label or the like;
      (ii) introducing said granulated product into a gas stream to separate
           said granules from said pieces in said gas stream; and
      (iii) removing at least some of said pieces from said gas stream.

3. A method according to claim 1 or claim 2 wherein steps (ii) and (iii) are
   repeated until substantially all of said pieces are removed from said gas
   stream.
4. A method according to any one of claims 1 to 3 wherein step (i) is carried out at the same location as steps (ii) and (iii).

5. A method according to any one of claims 1 to 3 wherein step (i) is carried out at a remote location and transported to the location of steps (ii) and (iii).

6. A method according to claim 2 or claim 3 wherein said granules or said granulated product is in the range of 8 to 10 mm.

7. A method according to any one of the preceding claims wherein said first and second plastic materials are different.

8. A method according to any one of the preceding claims wherein said first plastics material is poly carbonate and said second plastics material is selected from any one or a combination of a styrene polymer, styrene copolymer or an acrylonitrile-butadiene-styrene (ABS) copolymer.

9. A method according to any one of the preceding claims wherein said optical storage medium is any one or a combination of a CD, CD-ROM, CD-R, CD-RW, CD-DA, CD-1, DVD-ROM, DVD-R or DVD-RW.

10. A method according to any one of the preceding claims wherein said gas stream is an air stream.

11. A method for the recovery of plastics material from one or more material(s) containing at least two different plastics, the method comprising the steps of:

granulating said one or more materials to produce granules of each of the different plastics materials; and

submerging said granulated material in a liquid having a specific gravity equal to or falling between the specific gravity of one of said plastics different and selectively recovering one of said plastics materials.

12. A method according to claim 11 wherein said plastics material is a laminate of two or more layers of plastics materials.
13. A method according to claim 12 wherein said plastics material is subjected to a preliminary treatment to separate the layers of said laminate.

14. A method according to claim 11 for the selective recovery of plastics material from:
   (a) at least one optical storage medium formed at least in part from a first plastics material; and
   (b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material, said second plastics material having a different specific gravity from said first plastics material,
      the method comprising submerging granules of said optical storage medium and said storage container in a liquid having a specific gravity equal to or falling between the specific gravity of one of said first and second plastics material and selectively recovering one of said plastics materials.

15. A method for the recovery of plastic material from a combination of:
   (a) at least one optical storage medium formed at least in part from a first plastics material;
   (b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and
   (c) at least one insert, label, wrapper or the like, the method comprising:
      (i) providing said optical storage medium and said storage container in the form of granules and said insert, label, wrapper or the like in the form of pieces or the like;
      (ii) introducing (i) into a gas stream to separate said granules from said pieces in said gas stream; and
      (iii) removing at least some of said pieces from said gas stream;

   wherein the method further comprises submerging said separated granules in a liquid having a specific gravity equal to or falling between the specific gravity of one of said first and second plastics material and selectively recovering one of said plastics materials.

16. A method for the recovery of plastic material from the combination of:
(a) at least one optical storage medium formed at least in part from a first plastics material;
(b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and
(c) at least one insert, label or the like, the method comprising:
   (i) subjecting said optical storage medium, said storage container and said insert, label or the like to granulation to produce a granulated product comprising plastic granules and pieces of said insert, label or the like;
   (ii) introducing said granulated product into a gas stream to separate said plastic granules from said pieces in said gas stream; and
   (iii) removing at least some of said pieces from said gas stream;
wherein the method further comprises submerging said separated granulated product in a liquid having a specific gravity equal to or falling between the specific gravity of one of said first and second plastics material and selectively recovering one of said plastics materials.

17. A method according to any one of claims 14 to 16 wherein said liquid is a solution.

18. A method according to claim 14 wherein said solution is a salt solution.

19. A method according to claim 18 wherein said salt is sodium chloride.

20. A method according to any one of claims 14 to 19 wherein the specific gravity of said liquid is in the range of 1.02 to 1.2.

21. The method according to any one of claims 14 to 19 wherein the specific gravity of said liquid is about 1.02.

22. A method according to any one of the preceding claims when applied to a plastic material of said optical recording medium incorporating a metal film, said method further comprising the step in which at least a portion of the metal associated with said plastics material is recovered.
23. A method according to claim 22 wherein said plastics material is in the form of granules or granulated product incorporating said metal.

24. A method according to claim 22 or claim 23 wherein said metal is recovered by subjecting the separated granules to wet mechanical agitation.

25. A method according to claim 24 wherein said wet mechanical agitation is carried out in the presence of a granular abrasive material.

26. A method according to claim 25 wherein said granular abrasive material is sand.

27. A method according to any one of claims 24 to 26 wherein said wet mechanical agitation is performed in a hammer mill.

28. A plastic material recovered by the method according to any one of the preceding claims.

29. A metal recovered by the method according to any one of claims 22 to 27.

30. An apparatus for the recovery of plastic material from the combination of:
   (a) at least one optical storage medium formed at least in part from a first plastics material;
   (b) at least one storage container adapted for holding said optical storage medium, the storage container being formed at least in part from a second plastics material; and
   (c) at least one insert, label or wrapper, the apparatus comprising:
       (i) granulation means for granulating said first and second plastics material and for forming pieces of said paper or the like;
       (ii) at least one column provided with a means for providing a flow of gas and means for removal of paper from said column; and
       (iii) a settling tank or the like containing a liquid of preselected specific gravity.
31. An apparatus according to claim 30 wherein said granulation means includes a set of knives or the like on a rotary stator.

32. An apparatus according to claim 30 or claim 31 wherein said granulation means is equipped with a vacuum chamber positioned below said rotary knives.

33. An apparatus according to any one of claims 30 to 32 wherein the flow of gas through at least one column is controllable by means of a valve.

34. An apparatus according to any one of claims 30 to 32 wherein said apparatus is equipped with a plurality of columns, each of said columns communicating at or adjacent their base with an adjacent column to allow granulated plastics material to pass therebetween.

35. An apparatus according to claim 34 wherein the flow of gas through said plurality of columns is controlled by using columns of different diameters.

36. An apparatus according to claim 34 wherein the flow of gas through said plurality of columns is controlled by the use of a combination of valves and columns of different diameters.

37. An apparatus according to any one of claims 30 to 36 wherein each said column is provided with an opening adjacent the top thereof to allow paper to be blown out of said column into a collection point.

38. An apparatus according to any one of claims 30 to 37 wherein said gas is air.

39. An apparatus according to claim 38 wherein the flow of air may be provided by at least one fan, blower, compressor or the like.

40. An apparatus according to claim 39 wherein each said column has an associated fan, blower, compressor or the like.
41. An apparatus according to any one of claims 30 to 40 wherein said settling tank has a sloping floor and skimmer means for skimming off granular material flowing on a surface of a liquid contained in said settling tank and a screw conveyor means or the like for conveying said granular material from the floor of said tank to a location above the floor of said tank.

42. An apparatus according to claim 41 wherein said skimmer means are a set of paddles or the like connected by a set of mechanically driven circular chains to provide a continual skimming of said liquid surface.

43. An apparatus according to any one of claims 30 to 42 when used in accordance with the method of any one of claims 1 to 27.

44. A method according to any one of claims 1 to 27 substantially as hereinbefore described with particular reference to the preferred embodiments.

45. An apparatus according to any one of claims 30 to 43 substantially as hereinbefore described with particular reference to the figures and/or the preferred embodiments.
### A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.: B03B 7/00, 5/28, 5/30, B07B 4/00, B29B 17/00, 17/02

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

DWPI: B03B 7/00, 5/-, B07B 4/- to 11/-, B29B 17/- and keywords: gas, density, optical, compact, laminate and similar terms

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 4728045A (TOMASZEK) 1 March 1988 Claims</td>
<td>1-45</td>
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<td>CA 2115595A (KOPISCHKE) 13 August 1994 Abstract</td>
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<td>X</td>
<td>Derwent Abstract Accession No.94-196544/24, class A35 JP 06134762 A (HONDA MOTOR CO LTD) 17 May 1994 Abstract</td>
<td>11-14,17-21, 44 21-27, 29</td>
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  *"A"* document defining the general state of the art which is not considered to be of particular relevance
  *"E"* earlier application or patent but published on or after the international filing date
  *"L"* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  *"O"* document referring to an oral disclosure, use, exhibition or other means
  *"P"* document published prior to the international filing date but later than the priority date claimed
  *"T"* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  *"X"* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  *"Y"* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  *"&"* document member of the same patent family

Date of the actual completion of the international search: 30 October 2002

Date of mailing of the international search report: 02 Nov 2002

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

M. BREMERS
Telephone No: (02) 6283 2052
<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>Y</td>
<td>Derwent Abstract Accession No. 97-187672/17, classes A89, G06, L03 JP 09048025A (VICTOR CO OF JAPAN) 18 February 1997 Abstract</td>
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU02/01280

Box I  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.☐ Claims Nos:
   because they relate to subject matter not required to be searched by this Authority, namely:

2.☐ Claims Nos:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.☐ Claims Nos:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Extra Sheet

1.☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2.☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4.☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest  ☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.
Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

**Continuation of Box No: II**

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are different inventions as follows:

1. Claims 1-10, 15-17, 20-45 (excluding appendices back to claims 10-14) are directed to methods for the recovery of optical storage medium plastic material comprising a mixture of at least two different types of plastics material and a label(wrapper material by granulating the material and introducing the granules into a gas stream to remove the label(wrapper material. It is considered that separation of plastics from label(wrapper material by gas stream comprises a first “special technical feature”.

2. Claims 11-14 are directed to method of separation of at least two types of plastics in a mixture using a liquid having a particular specific gravity such that one type of plastic floats and the other type of plastic sinks. It is considered that the use of a liquid having a particular specific gravity for separating different types of plastics comprises a second “special technical feature”.

Since the abovementioned groups of claims do not share any of the technical features identified, a “technical relationship” between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept, a priori.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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END OF ANNEX