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(54) **Waste recovery using phosphorescence**

(57) Waste recovery, and particularly a method of sorting plastics waste material by incorporating therein a phosphor capable of phosphorescing when exposed to an appropriate light source of a specific wavelength.

The resulting phosphorescence is used to trigger a signalling device to activate means capable of separating the waste into like materials for recycling.

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WASTE RECOVERY

This invention relates to waste recovery and particularly to a method of sorting waste materials into selected types.

For some time there has been concern that packaging materials and particularly plastics packaging materials are being destroyed or
5 disposed of in landfill sites along with other waste materials when recycling would be more appropriate if they could be readily and satisfactorily sorted.

Plastic materials are very largely derived from raw materials obtained from natural resources such as petroleum or cellulose by
10 the application of energy intensive processes. It is the concern over dwindling natural resources and over the need for energy conservation that has inspired efforts towards commercial waste recovery.

While attempts have been made to sort waste plastic materials
15 from other waste materials, there has been a continuing need for means to efficiently sort the plastic materials into their various types.

In order to recycle plastic materials and particularly thermoplastic materials effectively it is generally important to
20 ensure that polymer types which are incompatible with one another are separated from one another before re-use. It is clearly necessary to do this effectively and efficiently to satisfy the demands of any commercial operation utilizing the sorted waste.

Certain plastic materials fluoresce inherently when subjected
25 to light of appropriate wavelength and, although this property may

be used as a tool to identify such materials, any system of sorting would be limited in its efficacy since reliability would have to be placed on the materials sorted fluorescing.

While it may be possible to add fluorescing compounds to
5 plastic materials during manufacture or fabrication to broaden the spectrum of materials that could be sorted, interference from fluorescent print used in labelling could easily render a sorting system so based unreliable.

The use of fluorescence to assist sorting is known in diamond
10 mining where diamonds are caused to fluoresce to enable them to be identified amongst the dross but where interfering outside influences are minimal.

There is thus a need for a reliable and effective method of
sorting plastic waste materials where the effects of outside
15 influences may be minimal.

According to the present invention there is provided a method
for sorting one or more components of a mixture of waste materials comprising at least one plastics waste material having incorporated therein a phosphor capable of phosphorescing when exposed to light
20 of a specific wavelength and/or band, applying such light to the mixture so as to cause the phosphor in said plastics waste material to phosphoresce, detecting such phosphorescence and thereby producing a signal, using said signal to activate means to cause the components of said plastics waste material to assemble together and
25 simultaneously or subsequently separating said assembled components from the waste materials.

Apparatus for carrying out the foregoing method is also within the scope of this invention.

Plastics materials which may be components of waste materials
30 particularly household waste include for example, regenerated cellulose, polyvinyl chloride, polyethylene terephthalate and high, medium and low (including linear low) density polyethylene.

Phosphors which may be used include organic and inorganic compounds which may be added during manufacture of the
35 plastics material or during its fabrication. Additionally or

alternatively the phosphor may comprise chemical groups which are incorporated into or added to the polymer chain.

Examples of suitable inorganic phosphors are MgSiO_3 , ZnSiO_4 with a trace of manganese, CaSiO_3 similarly with a trace of manganese, KCl with a trace of Thallium or NaBr with a trace of Thallium and copper or Manganese activated ZnSO_4 .

Organic phosphors include certain heterocyclic compounds and substituted anilines also activated cross-linked urea formaldehyde and cross-linked melamine formaldehyde resins, the activators for which may be diphenyl carbazole and para amino benzoic acid respectively. Examples of phosphors comprising chemical groups for incorporation into or addition to polymer chains will correspondingly be apparent to the skilled addressee.

The phosphors used to identify different plastics types may be selected to respond differently to a single wavelength of incident light and/or chosen to respond individually to selected wavelengths of a wave band.

In this specification the term light should be interpreted as including any visible or invisible radiation such as electromagnetic radiation.

Detectors of the phosphorescence of a particular plastics type or types may be tuned to detect a specific emitted wavelength or waveband according to the nature of the phosphor and degree of sorting required. Such detectors may be in the form of photo-cells or similar radiation sensitive devices of suitable sensitivity and range to detect the emitted phosphorescence whether or not such wavelength or intensity is normally visible to the naked eye.

As will be appreciated such detectors may operate by emitting a signal which may be electronic and which can be readily utilized through appropriate circuitry for example, to activate means to cause the components of at least one plastics material to assemble together, such as valves controlling air blasts or other devices controlling the projection or movement of the selected elements in order to effect assembly. Such assembly may be within the matrix of

other waste material for subsequent separation or may be with simultaneous separation from other waste material.

In operation of the method of this invention it is preferred that the waste material is initially comminuted or ground to a flowable medium in which the particle size may have a predetermined maximum. This maximum may be determined by a number of factors which include the handleability of the medium, the nature of the phosphorescence detectors and the nature and capability of the means to cause components to assemble for example.

Whilst it is preferable to maintain a dry medium where transport of the waste material may be in air or other gas, clearly suspension of the waste material in a liquid can be a practical alternative or addition.

It will be appreciated that the separation of one or more plastics from waste material according to the method of this invention may be effected utilizing a number of stages in which progressive separation can be effected. Further, where for example two or more plastics types are separated together from admixtures thereof with other waste material, it will be appreciated that such plastic types may be separated from one another subsequently by for example utilizing density differences or other such inherent differences and appropriate means such as flotation, centrifugation and electrostatic means for example.

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Claims

1. A method of sorting one or more components of a mixture of waste materials comprising at least one plastics waste material having incorporated therein a phosphor capable of phosphorescing
5 when exposed to light of a specific wavelength and/or band, applying such light to the mixture so as to cause the phosphor in said plastics waste material to phosphoresce, detecting such phosphorescence and thereby producing a signal, using said signal to activate means to cause the components of said plastics waste
10 material to assemble together and simultaneously or subsequently separating said assembled components from the waste materials.
2. Apparatus for sorting one or more components of a mixture of waste materials which comprises means to subject the mixture of waste materials containing distributed elements of at least one
15 plastic material having incorporated therein a phosphor capable of phosphorescing when exposed to light of a specific wavelength and/or band, means for applying such light to the mixture so as to cause the phosphor in said plastics waste material to phosphoresce, a detector responsive to such phosphorescence to thereby produce a
20 signal, means responsive to said signal causing the components of a least one plastics material to assemble together either separated as such or for subsequent separation from other waste material and means as appropriate for said subsequent separation.

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