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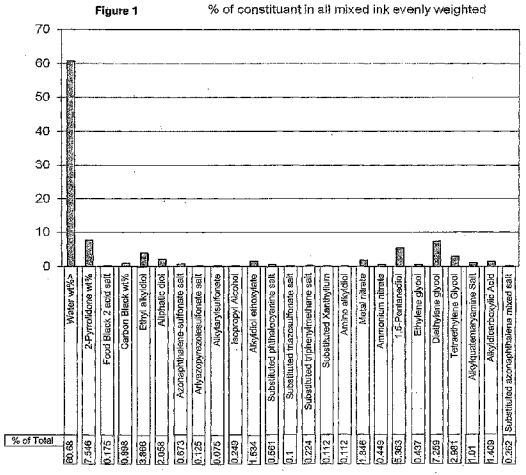
(54) **Title**: A METHOD AND SYSTEM FOR THE FORMATION OF USEABLE INK PRODUCTS FROM WASTES



(57) **Abstract**: The present invention relates to the field of manufacturing and/or reclaiming compounds which can be reused as ink and/or additives to ink, paint, and pigments. In one form, the invention relates to the formation of useable ink products or ink, dye, paint or pigment additives from wastes. Specifically, the present invention relates to the reclamation and/or re-use of ink from waste and/or recycled inkjet cartridges.

A METHOD AND SYSTEM FOR THE FORMATION OF USEABLE INK PRODUCTS FROM WASTES

FIELD OF INVENTION

The present invention relates to the field of manufacturing and/or reclaiming compounds which can be used in ink, dye or paint.

In one form, the invention relates to the formation of useable ink, dye or paint products from wastes. Specifically, the present invention relates to the reclamation and/or re-use of ink from waste and/or recycled inkjet cartridges.

It will be convenient to hereinafter describe the invention in relation to reclamation and/or re-use of ink from inkjet cartridges, however it should be appreciated that the present invention is not limited to that use only.

BACKGROUND ART

Throughout this specification the use of the word "inventor" in singular form may be taken as reference to one (singular) inventor or more than one (plural) inventor of the present invention. The discussion throughout this specification comes about due to the realisation of the inventor(s) and/or the identification of certain prior art problems by the inventors.

The inventor has realised that there are significant environmental and waste problems arising from the recycling of inkjet cartridges. Figure 1 illustrates the various chemicals present in only one brand of inkjet cartridge ink. Each brand has different chemistries, including different chemical compositions and different physical and chemical characteristics. One issue which has proved to be problematic is a contamination issue arising from the various brands, chemistries and colours involved in the recycling of waste inkjet cartridges. Presently, inkjet cartridges are, in the main, sent to landfill and/or incineration, neither of which provides a solution considered suitable in today's environmentally conscience community.

The inventor has also realised that there are significant commercial opportunities for solutions to the recycling and/or reuse of waste products, especially the recycling from electronics products and related consumables.

Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material forms a part of the prior art base or

the common general knowledge in the relevant art in Australia or elsewhere on or before the priority date of the disclosure and claims herein.

SUMMARY OF INVENTION

An object of the present invention is to alleviate the problem of waste inkjet cartridges, specifically the ink resident in the cartridges.

It is an object of the embodiments described herein to overcome or alleviate at least one of the above noted drawbacks of related art systems or to at least provide a useful alternative to related art systems.

In a first aspect of embodiments described herein there is provided a .method of and/or apparatus for deriving ink from inkjet cartridge(s), comprising reducing the size of the inkjet cartridges in order to liberate at least a portion of ink resident in the cartridges, and testing the liberated ink to ascertain whether any additives, and what processes are to be applied to the liberated ink.

In another aspect of embodiments described herein there is provided a method of, and / or apparatus for, deriving ink adapted for use in writing instruments and other applications, comprising obtaining inkjet cartridges and liberating at least a portion of ink resident in the cartridges.

In yet a further aspect of embodiments described herein there is provided ink adapted for use in writing instruments or for printing or other purposes, the ink comprising ingredients at least partially derived from inkjet cartridges.

In still a further aspect of embodiments described herein there is provided a writing or printing instrument adapted to impart indicia using ink as disclosed herein.

Other aspects and preferred aspects are disclosed in the specification and/or defined in the appended claims, forming a part of the description of the invention.

In essence, embodiments of the present invention stem from the realization that ink emanating substantially from waste and/or recycled inkjet cartridges can be collected, processed and reused, for example in writing instruments such as fountain pens, rollerball pens, ballpoint pens, felt markers etc. and in other applications like paint, calligraphy ink, and inkjet printing.

The recycled inkjet cartridges include a variety of makes and models and therefore a variety of substantially incompatible ink chemistries and colours and

thus in the past there have been contamination and other technical issues with recovering and reusing ink from waste inkjet cartridges.

Advantages provided by the present invention comprise the following:

- To reduce the lifecycle impacts of inkjet printing or printing with inkjet cartridges
- To reduce the environmental impact of inkjet printing or printing with inkjet cartridges
- To enable reuse of a potentially hazardous waste product
- To enable reuse of non renewable resources
- To alleviate the commercial and environmental cost of disposing of inkjet cartridges and/or the components (raw materials) of inkjet cartridges
- To assist inkjet printer and cartridge manufacturers to meet their social, environmental, sustainability, and good governance objectives
- To provide environmentally favourable choices for users of writing instruments, and other ink and paint products
- To provide an alternative supply of ink for use in writing instruments and other applications, such as (without limitation), fountain pens, rollerball pens, artist supplies, felt marker pens, ball point pens, inkjet printing, paint etc.
- To provide a recycled ink product into the market

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Further disclosure, objects, advantages and aspects of the present application may be better understood by those skilled in the relevant art by reference to the following description of preferred embodiments taken in conjunction with the accompanying drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and in which:

Figure 1 illustrates a representation of the various chemicals present in several models from only one brand of inkjet cartridge.

Figure 2 illustrates a flow chart representing one embodiment of an aspect of the present invention, and

Figure 3 illustrates a summary of an approximate composition of the ink according to a second embodiment of the present invention

DETAILED DESCRIPTION

In one preferred embodiment, a method and apparatus for recovering and reusing waste ink from recycled inkjet cartridges is disclosed.

Figure 1 illustrates a chemical analysis of a random sample of ink from different printers. Figure 1 also illustrates an example of the type of residual ink which is used as an input to the process of the present invention. Inks comprise (1) colourants such as pigments and dyes, (2) carriers that transport the colourants during the printing operation, (3) additives to adjust the physical properties of the ink, and (4) solvents that adjust speed of drying, viscosity and transport of the colourant. These materials are the inputs to the process of the present invention. For example, the inputs include but are not limited to water based dye, water based pigment, and water based solvent inks including all colours but predominantly black, cyan, yellow, and magenta. It is to be noted that the chemistry and colour of the residual ink inputs may vary from time to time dependent upon the type and nature of the ink cartridges which are provided as inputs to the present invention.

In accordance with one embodiment of the present invention, waste inkjet cartridges are processed to liberate any residual ink. Figure 2 illustrates a flowchart 200 representing this embodiment, in general. In accordance with an aspect of the present invention, the cartridges are derived from waste cartridges, such as post consumer, imaging supplies, supplies for desktop and/or commercial inkjet printing devices and/or post industrial cartridge material. These cartridges preferably provide substantially the input to the process of the present invention. Alternatively, the cartridges may be mixed with other inputs which may be used to produce a usable ink.

The ink may be liberated preferably by size reduction 201, such as shredding of the ink cartridges. The various component parts of the inkjet

cartridge are substantially separated from the ink 202, for example by centrifuging the size reduced inkjet cartridges. The liberated ink consists of numerous chemistries and colours. The present invention is directed to the ink liberated from the inkjet cartridges, regardless of how the ink is liberated.

Following size reduction 201, the liberated ink is filtered 203 to preferably remove at least some of the contaminants of the size reduction step. An example of the filtration is ultra-fine filtration, for example to remove matter less than 100 micron. More specifically the filtration should be adapted to filter particles less than 30 micron, or even less than 5 micron.

The filtered ink is then homogenised 204 in order to mix the various chemicals and/or colours together to obtain a relatively consistent and stable mixture.

The homogenised mix is then tested 205 to ascertain certain chemical and physical parameters and if any additives are necessary. The testing includes any one or any combination of (but is not limited to):

1. Visual inspection: of bulk and sample ink containers, to identify any residues, ink separation, odour or other characteristics relating to the quality of the reclaimed ink materials;
2. Spectroscopic analysis: to determine chemical composition or optical characteristics;
3. Colour Test: to determine ink darkness (intensity and opacity) and ink colour (hue);
4. Filtration tests: to monitor quality and determine product stability, typically using single or cumulative aliquot filtration tests;
5. Viscosity: to determine the ink fluidity at standard temperature and shear rate;
6. Interfacial surface tension: to determine the interaction of ink with substrates;
7. Non volatile residue (total solids): to determine the amount of non-volatile materials within the ink composition;
8. pH test: to determine the acidity or alkalinity of the recycled ink;
9. Corrosion tests: to determine corrosive effects if any, on materials in contact with the ink;

10. Microbial activity: to determine the sterility or microbial activity of the ink, if any, as pertaining to prolonged biological product stability;
11. Formulation stability: to determine the overall chemical and physical stability of the ink matrix upon storage and environmental exposure over time.

The additives, if needed, are introduced to the mix to supplement any ingredients lacking in the liberated ink and to minimise variability of colour and chemistry in order to produce ink suitable for the particular use such as writing instrument ink, etc. For example, the additives may be chosen from carbon black and/or other dyes and/or pigments (to provide some colouring or blackening of the product) and/or other chemicals and/or amines, and/or glycols, and/or alcohols to enhance the colour and/or the manner in which the ink presents on paper and/or to determine drying characteristics of the ink may be added. The additives, such as would be known by those skilled in the art may also be used to adjust the properties of the solvent (typically water) which impacts feathering properties of the ink. Equally, additives may be provided to enhance or alter the smell of the ink resulting from the process according to the present invention. The various additives which may be used in the present invention may be known to the skilled person, and added to provide a desired outcome / property of the useable ink.

In other words, the homogenised mix is changed to be aligned with the particular application, such as:

1. Fountain Pen Ink: water based fluid (main component about 55-75%) and comprising smaller levels in the range of 3 to 20% of glycols (diols, triols) amines etc to control the drying rate and penetration into paper based substrates and still keep the ink 'open' in the pen's reservoir and delivery (nib) system.
2. Rollerball ink: water based fluid (main component about 55-75%) and comprising smaller levels in the range of 3 to 20% of glycols (diols, triols) amines etc to control the drying rate and penetration into paper based substrates and still keep the ink 'open' in the pen's reservoir and delivery (nib) system.
3. Calligraphy ink: similar to fountain pen ink (above) but usually has a small amount of resinous material (shellac, cellulosic, acrylic, etc) of up to 5% to

allow the ink to 'sit' up more on the surface of the substrate and give it a small level of gloss for artistic effects.

4. Felt pen marker ink: comprises essentially a dye in solvent. There are two types:
   a. solvent based (xylene/toluene) which uses a solvent based dye. These are more permanent.
   b. water based types including whiteboard markers use dyes etc that dissolve in water/glycol systems and are relatively easily rubbed off.
   c. Semi permanent markers using water based dyes and/or pigments
5. Ball point ink: relatively high viscosity pastes which use glycol and solvent based dyes both milled and dissolved. The black colour is for example a standard waxoline oil black and the blue colour is for example triphenylmethane (Victoria Blue type). There are little or no resins, the ink delivery through the 'rolling' ball process depends on the thickness of the paste. The glycol allows it to penetrate somewhat and dry almost 'instantly'.
6. Flexographic inks – for use in printing applications for cardboard and paper.
7. Printing inks for other materials – such as inks for printing on plastics, fabric, timber, concrete, metal and/or other materials.
8. Inkjet inks such as Drop on Demand (DOD) or continuous inkjet printing applications through various nozzle types and configurations. These inks will usually be water based pigments, dyes or solvents.
9. Paints – of various compositions and for various uses.

Although the embodiment above describes the production of black colour ink, ink of any colour may be produced according to the present invention.

The ink obtained by virtue of the present invention 206 may be used in a variety of writing instruments and applications, such as, without limitation fountain pens, rollerball and ballpoint pens, quills, felt marker pens, inkjet inks and/or any ink based writing or printing instruments. The ink may also be used in a variety of applications, such as calligraphy, printing, screen printing, inkjet cartridges, printer ribbons, dye (such as fabric dye), paint and/or art supplies.

The table in Figure 3 provides a summary of an approximate composition of the ink according to a second embodiment of the present invention. A number of compositions reflect the use of the present invention in various writing instruments and applications. It is to be noted that the uses are only exemplary, and not limited only to those disclosed in the table. The 'typical recipe' represents the composition of currently available commercial brands of similar products. The 'L.base' represents liberated ink according to an aspect of the present invention. In this embodiment, the L.base ink has various compositions added to it (as is illustrated in the table) in order to obtain a resultant ink which can be used in the writing instruments shown.

In accordance with a third embodiment, the product is obtained by removal of the ink residues from printer cartridges. As the feedstock of cartridges contains many different colours, and the ink removal process is not necessarily colour selective, the overriding colour of the product is essentially black. However, it is also contemplated that the cartridges are sorted by colour prior to ink residue removal to facilitate production of a specific colour (non-black) ink.

The product, in accordance with this embodiment, is aqueous based.

The product is a black, water based liquid with a faint organic-type odour. Typically the chemical specification for the product is as follows:

pH	7.5 – 8.5
Specific Gravity	~1-2
Solubility in Water	Fully miscible in all proportions.
Solids	3 - 20% wt
Volatile organic component (VOC)	< 3.5% w/s
Colour	Black.

In a particularly preferred embodiment the product has a chemical specification as follows:

pH	5.5 - 9.0
Specific Gravity	Approx 1
Solubility in Water	Fully miscible in all proportions.
Solids	3 - 20% wt
VOC	< 7 % w/w

Colour Black, composite colour blends and not excluding yellow, magenta, cyan, white or any other inverse colour sets.

The product represents a relatively low cost source of aqueous based dyes and/or pigments for various coloured coatings such as inks, dyes and paints.

Inks: - fountain pen, rollerball, felt marker, whiteboard marker, ball point, inkjet (either drop on demand or continuous), calligraphy, flexographic cardboard etc.

Paints: - aqueous black base for colour support in low cost paints.

The product is the residual extraction of used digital inkjet printer cartridges. All colour ink cartridges, as well as black, are used in the recycling process, the resultant ink stream being a heavily toned black.

The following is a general breakdown of the main components of the product according to an embodiment of the invention:

- Colourant 0.5 – 20 %wt
- Carrier 5 – 70 %wt
- Additive 0.1 – 30 %wt
- Solvent 60 – 90 %wt

In a preferred embodiment the main components of the product according to the invention are as follows:

Water app. 65 – 80 %w/w

Dyes/pigments (black/colour) < 5 % w/w

Polar solvent (e.g. 2- pyrrolidone and derivatives) < 8 % w/w

Organic solvent (e.g. Diols, substituted diols and humectants) <20 % w/w

Surfactant (e.g. Ethoxylated surfactants) <5 % w/w

Ink additive (eg metal or ammonium nitrate salts) <3 % w/w

The following is a breakdown of the main components of a preferred product according to an embodiment of the invention:

Water ~ 65-70 %w/w

Dyes/pigments (black/colour)	3.5 - 4.0% w/w
2- pyrrolidone and alkylated derivatives	7 % w/w
Alkyl diols	4 - 5 % w/w
Alkyldiol ethoxylated based surfactants	2 - 3 % w/w
Nitrate salts (metal/ammonium)	1 - 2 % w/w

As the product is derived from extraction of ink cartridges from many sources there may be additional materials of similar chemical structure, i.e. diols and glycols with various alkyl chain lengths. These materials will contribute to the overall organic content. A typical composition of the product is set out below:

Compositional Details

Ingredient	**% weight**
Water	> 70
Alkylated heterocyclic additives	< 10
Water soluble non volatile materials	10 - 20 (typically ~12)
Water soluble solvents and co-solvents	< 5 -15 (typically ~5)
Water soluble or dispersible colourants	< 5 - 7 (typically ~7)
Water soluble nitrate salts	< 3
Surfactant additives	< 2 – 3 (typically ~3)
Other additives	< 5%

While this invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification(s). This application is intended to cover any variations, uses or adaptations of the invention following in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth.

As the present invention may be embodied in several forms without departing from the spirit of the essential characteristics of the invention, it should be understood that the above described embodiments are not to limit the present invention unless otherwise specified, but rather should be construed broadly within the spirit and scope of the invention as defined in the appended claims.

The described embodiments are to be considered in all respects as illustrative only and not restrictive.

Various modifications and equivalent arrangements are intended to be included within the spirit and scope of the invention and appended claims. Therefore, the specific embodiments are to be understood to be illustrative of the many ways in which the principles of the present invention may be practiced. In the following claims, means-plus-function clauses are intended to cover structures as performing the defined function and not only structural equivalents, but also equivalent structures. For example, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface to secure wooden parts together, in the environment of fastening wooden parts, a nail and a screw are equivalent structures.

It should also be noted that where a flowchart is used herein to demonstrate various aspects of the invention, it should not be construed to limit the present invention to any particular logic flow or logic implementation. The described logic may be partitioned into different logic blocks (e.g., programs, modules, functions, or subroutines) without changing the overall results or otherwise departing from the true scope of the invention. Often, logic elements may be added, modified, omitted, performed in a different order, or implemented using different logic constructs (e.g., logic gates, looping primitives, conditional logic, and other logic constructs) without changing the overall results or otherwise departing from the true scope of the invention.

"Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof." Thus, unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of deriving ink from inkjet cartridge(s), the method comprising the steps of:

reducing the size of the inkjet cartridges in order to liberate at least a portion of ink resident in the cartridges, and

testing the liberated ink to ascertain whether any additives are to be added to the liberated ink.

2. A method as claimed in claim 1, further comprising the step of filtering the liberated ink.

3. A method as claimed in claim 1 or 2, further comprising the step of homogenising (milling, mixing, blending) the liberated ink.

4. A method as claimed in claim 1, 2 or 3, wherein the additives are chosen from the group comprising colourants including carbon black, dyes and pigments; solvents; carriers; humectants; wetting agents; dispersing agents; compounds that adjust physical parameters; and combinations thereof.

5. A method of deriving ink adapted for use in writing instruments, the method comprising the steps of;

- obtaining inkjet cartridges, and
- liberating at least a portion of ink resident in the cartridges.

6. A method as claimed in claim 5, wherein the liberated ink is further processed in order to adjust chemical and/or physical characteristics.

7. Ink adapted for use in writing instruments or for printing purposes, the ink comprising ingredients at least partially derived from inkjet cartridges.

8. Ink as claimed in claim 7, wherein at least two of the inkjet cartridges each have a different ink chemistry.

9. Ink as claimed in claim 7 or 8, wherein the ink is substantially wholly derived from inkjet cartridges.

10. Apparatus adapted to derive ink from inkjet cartridges, said apparatus including:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method as claimed in any one of claims 1 to 6.

11. A writing or printing instrument adapted to impart indicia using ink as claimed in any one of claims 7 to 10.

12. A writing or printing instrument adapted to impart indicia using ink as derived by the method as claimed in any one of claims 1 to 6.

13. A method as herein disclosed.

14. An apparatus and/or device as herein disclosed.

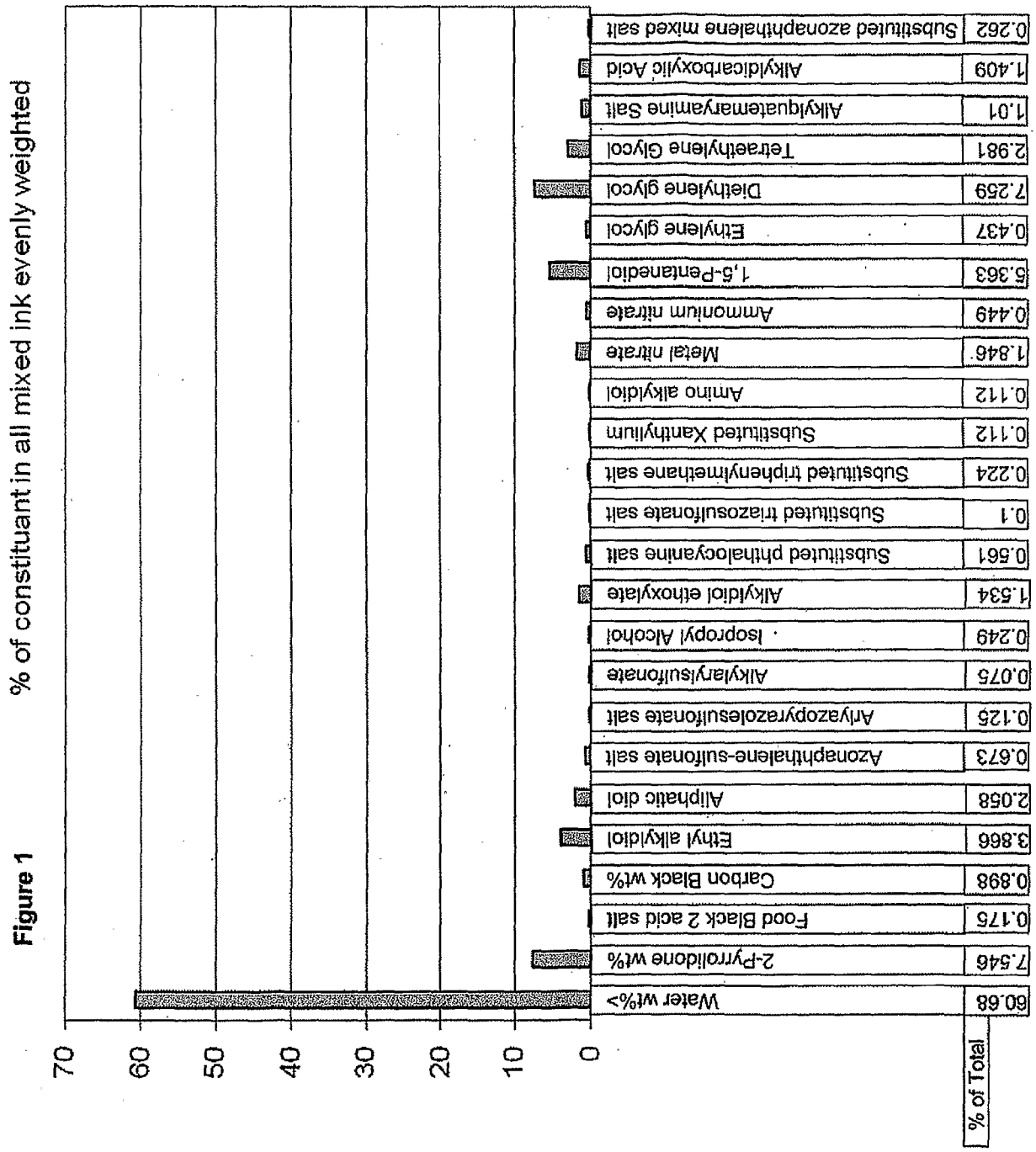


Figure 1
% of constituant in all mixed ink evenly weighted
70
60
50
40
30
20
10
0
% of Total
60.68 Water wt%>
7.546 2-Pyrrolidone wt%
0.175 Food Black 2 acid salt
0.898 Carbon Black wt%
3.866 Ethyl alkyldiol
2.058 Aliphatic diol
0.673 Azonaphthalene-sulfonate salt
0.125 Arlyazopyrazolesulfonate salt
0.075 Alkylarylsulfonate
0.249 Isopropyl Alcohol
1.534 Alkyldiol ethoxylate
0.561 Substituted phthalocyanine salt
0.1 Substituted triazosulfonate salt
0.224 Substituted triphenylmethane salt
0.112 Substituted Xanthylium
0.112 Amino alkyldiol
1.846 Metal nitrate
0.449 Ammonium nitrate
5.363 1,5-Pentanediol
0.437 Ethylene glycol
7.259 Diethylene glycol
2.981 Tetraethylene Glycol
1.01 Alkylquaternaryamine Salt
1.409 Alkyldicarboxylic Acid
0.262 Substituted azonaphthalene mixed salt

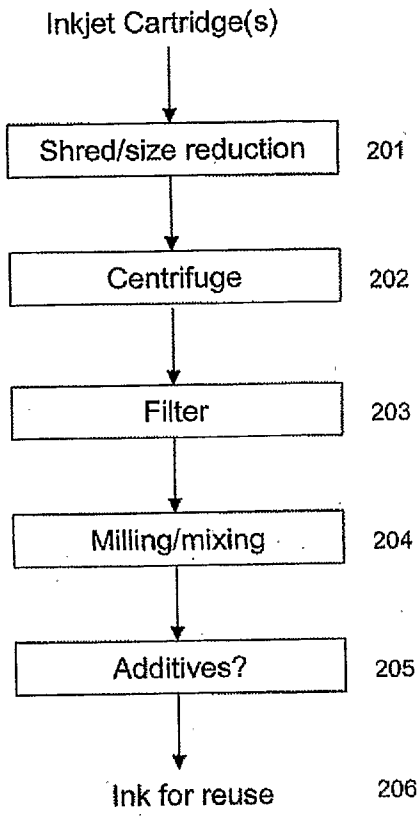

Inkjet Cartridge(s)
Shred/size reduction
201
Centrifuge
202
Filter
203
Milling/mixing
204
Additives?
205
Ink for reuse
206

Figure 2

Table 1.0 – Example formulations		
Example Use	**Typical recipe (% pbw)**	**New composition (% pbw)**
FOUNTAIN PEN INK		
Water	70 - 75 %	**L base** < 70 % (40 – 70%)
Glycol	10 – 14%	3.0 - 30.0% pbw
Dyes / pigments	3.5 - 10.2%	3.0 - 20.0% pbw
Surfactants	1.5 - 3.0%	1.0 - 2.5% pbw
Salts	0.5 - 2.0%	0.5 - 1.5% pbw
Diols / triols	4.0 - 10.0%	4.0 - 18.0%pbw
Amines	1.0 - 1.5%	1.0 - 2.0%pbw
BALLPOINT PEN INK		
Resin	5 – 10	2.0 - 8.0
Thickener	0.2 - 0.4	1 -2
Colorant	10 - 20	5 – 10
Glycol	70 - 75	60 - 70
Additives	0.5 - 1.5	**L base** 15 – 35%
CALLIGRAPHY / ART SUPPLIES INK		
Water	64.0	**L base** 65 - 85%
Glycol	22.0	15 – 20
Resin	4.0	3 - 8
Colorant (dye/pigment)	8.0	8 - 12
Ammonia (12%)	1.0	1 - 2
Additives	1.0	1 - 2
WATER BASED MARKER PEN INK		
Water	< 70	**L base** <80%
n. propanol	5	4 - 6
Prop glycol methyl ether	5	5 - 10
Ketone resin	5	4 - 8
Black dye	5	5 - 8
Wax/Veg oil 20/80, hot premix	5	4 - 6
L.base is liberated cartridge ink according to an aspect of the present invention		
Example Color	Black reclaimed ink	
Water content	> 70%	
Specific gravity	1.0 - 1.1	
PH	7.0 - 8.5	
% solids	3.5 - 15.5%	
Dyes / pigments	3.5 - 10.2%	
Surfactants	1.5 - 3.0%	
Salts	0.5 - 2.0%	
Diols / triols	4.0 - 10.0%	
Amines	1.0 - 1.5%	

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000207

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

C09D 11/00 (2006.01) ***B41J 2/175*** (2006.01) ***C08J 11/00*** (2006.01)

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 data base consulted during the international search (name of data base and, where practicable, search terms used)
Epodoc, wpi: ink_jet, recycle+, reclaim+, regenerat+, recover+, filter+, filtration or shred+ or centrifug+ or break+ or size reduc+, cartridge+ or tank+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/069544 A1 (CLOSE THE LOOP TECHNOLOGIES PTY LTD) 19 August 2004 See page 2 line 10-30, page 3 line 32-page 4 line 6, Figure 3	5, 7-10
X	Derwent Abstract Accession No.: 2006-757022/78, Class A35 L03, BR200501118 A, (ALVES & BERTONI ITU LTDA EPP), 5 September 2006 See abstract	5, 7-9
X	Derwent DWPI Online Abstract Accession No.: 1997-043722/05, DE 19521413 A1 (NOTHELFER, M.) 19 December 1996 See abstract	5

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"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	Date of mailing of the international search report
30 March 2009	15 APR 2009
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. +61 2 6283 7999	Authorized officer **KATHY WONG** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2737

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6119866 A (WAGNER et al.) 19 September 2000 See Figure 1, col 2 line 44-line 65, col 3 line 40-49	5
X	US 6383274 B1 (LIN) 7 May 2002 See col 3 line 10-17	7, 9
X	US 6312117 B1 (GAASCH) 6 November 2001 See col 2 line 64-line 8, col 3 line 64-col 3 line 6	7-9
X	EP 1947150 A1 (CANON KABUSHIKI KAISHA) 23 July 2008 See abstract	11, 12
X	US 5862753 A (DOLAN et al.) 26 January 1999 See abstract	11, 12
A	US 4874515 A (MCKELVEY) 17 October 1989 See col 5 line 62-col 6 line 10, col 8 line 4-line 11	1-9
A	US 5628914 A (PRASIL) 13 May 1997 See Figure1, col 4 line 4-15, col 7 line 25-28	1-9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000207

Box No. II 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.: **13, 14**
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:
The claims 13 and 14 do not comply with Rule 6.2(a) because they rely on references to the description and/or drawings.

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 No. III 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:

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 additional fees, this Authority did not invite payment of additional fees.
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 and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2009/000207

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.

Patent Document Cited in Search Report		Patent Family Member					
WO	2004069544	AU	2004210011	CN	1747839	EP	1599342
		MX	PA05008308	NZ	541561	US	2006209143
DE	19521413	NONE					
US	6119866	EP	0972570				
US	6383274	JP	2001207095				
US	6312117	NONE					
EP	1947150	JP	2007106995	US	2007148376	WO	2007032527
US	5862753	NONE					
US	4874515	US	4818284				
US	5628914	EP	0912217	WO	9712655		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX