Title: COMPOSITE SACRIFICIAL COMPONENTS

Abstract: Components (such as rotary mineral breaker wear tips and back up tips) made by: (i) positioning within a mould at least one hard transition metal carbide mass [preferably after pretreatment by heating to remove surface volatiles]; (ii) filling the mould about the transition metal carbide mass(es) with preferably either molten spheroidal graphite iron or molten nickel chromium alloy cast iron; and (iii) removing the composite moulding from the mould (whether by mould destruction or otherwise). A metallurgical bond between transition metal carbide mass(es) and the iron containing mass results. A preferred carbide is of tungsten or chromium (preferably bound particles thereof into an elongate form).
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
COMPOSITE SACRIFICIAL COMPONENTS

THE CURRENT INVENTION

The present invention relates to composite moulding practices and to related methods and products including composite sacrificial components.

Frequently there is a need to provide composite products including a sacrificial carbide content (e.g.; wear tips in mineral breakers, blade edges for diggers and back hoes, etc.). Usually such composite products are fabricated.

SUMMARY OF THE INVENTION


Such sacrificial components are to be incorporated in the machine so that erosion under the action of mineral pieces (e.g. rock) is minimised by the presence of a sacrificial tungsten carbide surface. Such components include wear tips (see US4662571) and backup tips (see US4586663). The nature of such components are described hereinafter by reference to appropriate drawings from the aforementioned patent specifications.

Traditionally such components have been formed by the fixing of carbide pieces (usually tungsten carbide) into a formed groove. Some previous such products have involved the milling of a groove in either a fabricated or cast carrier component and the fixing of the carbide material in such a groove by, for example, induction brazing.

The present invention recognises for one aspect of the invention the advantages to be derived for such sacrificial components were they to be formed directly into a final configuration as a composite component by a casting process where the carbide material is located in an appropriate mould. Composite moulding procedures have previously been disclosed in a number of US patents.
US Patent 5328776 (Garber et al) discloses a composite casting providing a wear resistant surface by virtue wear resistant elements (e.g. of white iron) being arrayed to present in a carrying ductile matrix alternating surface areas of wear resistant material and the matrix material (e.g. cast steel).

US Patent 5445916 (Revankar to Deere & Co) discloses a method for impregnating a metal product with a hard wear-resistant surface area (e.g. tungsten carbide, chromium carbide, and the like) on a cast matrix. Such a procedure involves first attaching the wear resistant layer (e.g. in the form of a sintered sheet) onto a mould surface and thereafter casting the matrix metal into the mould.

Whilst US5443916 refers to the use of a carbide/binder/plasticiser mixture to form both a sheet and pins from powders of carbide material. The pins serve the function of better anchoring the patterned surface of carbide powder on the surface of the cooled cast metal matrix. A heating process to from 320°C to 340°C is disclosed to remove organic binder and plasticizer of the sheet prior to the casting.

US Patent 4119459 (Eckmer et al) refers to carbide particulate being placed in a mould and the mould is then filled with molten iron.

US Patent 5337801 (Matertkowski) discloses hard carbide particles embedded in and bonded with a first cast steel matrix and the subsequent embedding thereof in a higher melting point steel.

The full content of each such patent is hereby here included by way of reference.

In a first aspect the invention consists in a method of preparing a mountable sacrificial component, said method comprising the steps of

(i) positioning within a mould at least one hard transition metal carbide mass [preferably after pretreatment by (inter alia) heating to remove surface volatiles],

(ii) filling the mould about the transition metal carbide mass(es) with either molten spheroidal graphite iron or molten nickel chromium alloy cast iron, and

(iii) removing the composite moulding from the mould (whether by mould destruction or otherwise),
wherein the resulting component provides a metallurgical bond between transition metal carbide mass(es) and the iron containing mass.

Preferably said metal carbide mass or masses is or are elongate and are preferably located in the ferrous material so as to extend such that in use they will be presented laterally to the eroding material which is to sacrifice the component.

Preferably said component is a sacrificial component of a mineral breaker.

Preferably said transition metal is tungsten or chromium (preferably tungsten).

In a second aspect the invention consists in a method of preparing a mountable sacrificial component, said method comprising the steps of

(i) positioning within a mould at least one tungsten carbide mass after pretreatment by (inter alia) heating to remove surface volatiles,
(ii) filling the mould about the tungsten carbide mass(es) with either molten spheroidal graphite iron or molten nickel chromium alloy cast iron, and
(iii) removing the composite moulding from the mould (whether by mould destruction or otherwise),

wherein the resulting component provides a metallurgical bond between the tungsten carbide mass(es) and the iron containing mass.

Preferably said metal carbide mass or masses is or are elongate and are preferably located in the ferrous material so as to extend such that in use they will be presented laterally to the eroding material which is to sacrifice the component.

Preferably said component is a sacrificial component of a mineral breaker (preferably of a BARMAC™ type).

Preferably the bond is substantially fully encompassing of the tungsten carbide mass(es).

Preferably said tungsten carbide mass(es) are elongate.

Preferably said tungsten carbide masses are shaped forms and are not particles e.g., such as might formed by breaking, crushing or the like.

Preferably said elongate mass(es) are cylindrical or rectanguloid in shape.

Preferably two aligned elongate tungsten carbide masses are positioned to have a favoured sacrificial zone in use (after initial erosion of some encompassing
iron containing material) which is initially away from the outer ends of the aligned masses, thereby to leave (in use) each such outer end at least to some extent encompassed by iron material even as (in use) the other end of each tungsten carbide mass is subject to erosion.

Preferably said pretreatment is by heating to at least 150°C (preferably 150°C to 200°C).

Preferably said tungsten carbide mass(es) is at less than 150°C at the time of the said filling of said mould e.g. preferably is at ambient temperature(s).

In some embodiments said positioning is in a sand mould (preferably using the green sand mould procedure) (preferably including a binder of, e.g., clay and/or a resin) using wire chaplets or equipment (preferably wire chaplets (e.g. of the shape described hereafter) of a medium carbide carbon spring steel). Preferably said chaplets are as hereinafter described with reference to the drawings.

Most preferably however the positioning of the carbide mass or carbide masses within the mould is by use of a procedure whereby a locating print is provided in the drag mould which assists carbide location, part of such locating print providing a “window” to the carbide material in the finally moulded article away from a region requiring the bond between the ferrous material and the carbide material. Preferably such “window” or “windows” is or are of a kind hereinafter described with reference to the accompanying drawings.

Preferably said tungsten carbide mass(es) are embedded in a plate like form of the iron containing material but at a zone of increased thickness thereof.

Preferably the sacrificial zone of the component has about 4mm or greater of iron containing material over the tungsten carbide mass(es).

Preferably said plate like form included a moulded opening or moulded openings to allow bolt or the like attachment thereof into a mineral breaking machine (e.g. a BARMAC™ machine of Svedala New Zealand Limited).

Preferably said openings are in a zone not of increased thickness and said openings are aligned to receive bolts or the like normal to the longitudinal axes of said elongate tungsten carbide masses yet spaced therefrom and aligned in a line parallel to the alignment axis of longitudinal axes of said tungsten carbide masses.
Preferably said component is a wear tip and said iron containing material is a nickel chromium alloy cast iron (e.g. Nihard).

In another preferment said component is a backup tip (see US Patent 4586663) as to the distinction between wear tips and backup tips) and the iron containing material is spheroidal graphite iron (i.e. "S.G. Iron").

Preferably the tungsten carbide mass or masses are those available packaged under the trademark SANDVIK™.

Preferably the iron containing material is more ductile than the tungsten carbide mass(Es) and less brittle (e.g. if S.G. Iron, can be stretched about 7%, and, if Nihard, can be stretched up to about 1%).

In another aspect the invention consists in a sacrificial component produced by a process of the present invention.

In another aspect the invention consists in a mineral breaker including a sacrificial component as aforesaid.

In still another aspect the invention consists in a wear tip or back up tip for a mineral breaker having at least one hard transition metal carbide shaped body at least substantially fully embedded by casting a metal matrix (preferably S.G. Iron or Nihard or High Chromium Iron about the body or bodies) as a metal carrier for the carbide body or bodies and adapted, by virtue of its to be mounted position with respect to the loci of mineral piece movement to erode in part to reveal a sacrificial surface area of the carbide body or bodies to subsequently be eroded by mineral pieces in use.

**BRIEF DESCRIPTION OF THE DRAWINGS**

One preferred form of the present invention will now be described with reference to the accompanying drawings in which;

**Figure 1** is a front view of a wear tip or a back up tip for a BARMAC™ type machine previously described, such a wear tip or back up tip being mountable using the openings shown through the ferrous body,

**Figure 2** is the reverse view of the article of Figure 1 showing the "windows" which show the outer regions of the elongate carbide pieces.
Figure 3 is an end view AA of the article of Figure 1 showing in broken outline the inner extent of the windows depicted in Figure 2.

Figure 4 is a transparent view of the article of Figures 1 and 2 or a pattern useful for would preparation purposes showing how preferably two elongate carbide rods are positioned in the ferrous mass,

Figure 5 is a view of the end BB in a similar manner to that of Figure 3,

Figure 6 is a perspective view of the transparent article of Figure 4, and

Figure 7 shows a wire chaplet type arrangement that can be used to secure a rod, if the window location feature of the article depicted in the drawings or a pattern such as depicted in Figures 4, 5 and 6, is not used in a moulding process.

In the preferred form of the present invention an elongate rod 1 is used in an aligned pair in the article extending to a region 2 where they butt and which preferably will be the region of maximum erosion in use of a wear tip or back up tip of the type depicted. Of course a single full length rod can instead be used.

The ferrous mass region 3 includes fixing holes 4 and of course the strengthened region 5 in which the rods 1 are embedded.

Windows 6 are provided such that when preparing the drag mould of a green sand mould upstands in the sand are printed onto which the aligned tungsten carbide rods can be positioned to span there between. When the mould is closed with the cope mould part, a mould cavity about the positioned rods will leave only a small exposure of the tungsten carbide material as shown in the transparency of Figure 6.

By employing such a "window" feature an outcome as depicted in Figures 1 through 3 is possible where the main region of erosion 7 is that which overlies the butted rods 2. Any appropriate means of butting the rods together can be utilised including wiring, adhesion, wire dowelling, etc, since it will be in short order that the tungsten carbide is exposed in a BARMAC™ type machine to a flow of eroding mineral pieces.

A person skilled in the art will appreciate how the process previously described with its preferred pretreatment of the carbide with heat provides securely embedded carbide pieces with an appropriate metallurgical bond to the ferrous matrix.
Figure 7 shows a wire chaplet of a kind having loops curved in planes that are normal with respect to each other such that one loop, with its extended distal end, can be positioned on the sand surface of a drag mould to leave upstanding the other loop into which an end of a horizontal rod of tungsten can be inserted.

Please note that any cross section for the tungsten carbide or other carbide pieces may be utilised although for ease of description reference throughout in respect of the drawings has been to an elongate rod like material.

The techniques of the present invention can provide components for many uses, eg, back hoes, excavators, etc.
CLAIMS:

1. A method of preparing a mountable sacrificial component, said method comprising the steps of
   (i) positioning within a mould at least one hard transition metal carbide mass [preferably after pretreatment by (inter alia) heating to remove surface volatiles],
   (ii) filling the mould about the transition metal carbide mass(es) with either molten spheroidal graphite iron or molten nickel chromium alloy cast iron, and
   (iii) removing the composite moulding from the mould (whether by mould destruction or otherwise),

   wherein the resulting component provides a metallurgical bond between transition metal carbide mass(es) and the iron containing mass.

2. A method of claim 1 wherein said metal carbide mass or masses is or are elongate.

3. A method of claim 2 wherein said mass or masses is or are located in the ferrous material so as to extend such that in use it or they will be presented laterally to the eroding material which is to sacrifice the component.

4. A method of any one of the preceding claims wherein said component is a sacrificial component of a mineral breaker.

5. A method of claim 4 wherein said mineral breaker is of a kind where a rotor flings mineral pieces against mineral pieces.

6. A method of any one of the preceding claims wherein said transition metal is tungsten or chromium.

7. A method of claim 6 wherein said mass or masses is or are each of a bound mass or unitary mass of tungsten carbine.

8. A method of preparing a mountable sacrificial component, said method comprising the steps of
   (i) positioning within a mould at least one tungsten carbide mass after pretreatment by (inter alia) heating to remove surface volatiles.
   (ii) filling the mould about the tungsten carbide mass(es) with either
molten spheroidal graphite iron or molten nickel chromium alloy cast iron, and

(iii) removing the composite moulding from the mould (whether by mould
destruction or otherwise),

wherein the resulting component provides a metallurgical bond between the
tungsten carbide mass(es) and the iron containing mass.

9. A method of claim 8 wherein said tungsten carbide mass or masses is or are
elongate.

10. A method of claim 9 wherein said mass is or said masses are located in the
ferrous material so as to extend such that in use they will be presented laterally to the
eroding material which is to sacrifice the component.

11. A method of claim 8 or 10 wherein said component is a sacrificial component
of a mineral breaker.

12. A method of any one of claims 8 to 11 wherein the bond is substantially fully
encompassing of the tungsten carbide mass(es).

13. A method of any one of claims 8 to 12 wherein said tungsten carbide masses
are shaped forms and are not particles e.g., such as might formed by breaking,
crushing or the like.

14. A method of any one of claims 8 to 13 wherein said mass is or masses are
elongate and cylindrical or rectanguloid in shape.

15. A method of any one of claims 8 to 14 wherein two aligned elongate tungsten
carbide masses are positioned to have a favoured sacrificial zone in use (after initial
erosion of some encompassing iron containing material) which is initially away from
the outer ends of the aligned masses, thereby to leave (in use) each such outer end at
least to some extent encompassed by iron material even as (in use) the other end of
each tungsten carbide mass is subject to erosion.

16. A method of any one of claims 8 to 15 wherein said pretreatment is by
heating to at least 150°C.

17. A method of claim 16 wherein said heating is to the range of from 150°C to
200°C.

18. A method of any one of claims 8 to 17 wherein said tungsten carbide mass(es)
is (are) at less than 150°C at the time of the said filling of said mould.
19. A method of claim 18 wherein said mass(es) is (are) at ambient
temperature(s) at the time of filling said mould is at ambient temperature(s).
20. A method of any one of claims 8 to 19 wherein said positioning is in a sand
mould.
21. A method of claim 20 where a green sand mould procedure is used.
22. A method of claim 20 wherein said sand includes a binder.
23. A method of claim 22 wherein said binder is a clay and/or a resin.
24. A method of claim 20 wherein said positioning is with the use of wire
chaplets.
26. A method of claim 25 wherein the chaplets are of medium carbide carbon
spring steel.
27. A method of claim 24, 25 or 26 wherein said chaplets are as hereinbefore
described with reference to the drawings.
28. A method of claim 20 wherein the positioning of the carbide mass or carbide
masses within the mould is by use of a procedure whereby a locating print is
provided in the drag mould which assists carbide location, part of such locating print
providing a “window” to the carbide material in the finally moulded article away
from a region requiring the bond between the ferrous material and the carbide
material.
29. A method of claim 28 wherein said “window” or “windows” is or are of a
kind hereinafter described with reference to the accompanying drawings.
30. A method of any one of claims 8 to 29 wherein said tungsten carbide mass(es)
are embedded in a plate like form of the iron containing material but at a zone of
increased thickness thereof.
31. A method of claim 30 wherein said plate like form included a moulded
opening or moulded openings to allow bolt or the like attachment thereof into a
mineral breaking machine.
32. A method of any one of claims 8 to 31 wherein the sacrificial zone of the
component has about 4mm or greater of iron containing material over the tungsten
carbide mass(es).
33. A method of claim 32 wherein said openings are in a zone not of increased thickness and said openings are aligned to receive bolts or the like normal to the longitudinal axes of said elongate tungsten carbide masses yet spaced therefrom and aligned in a line parallel to the alignment axis of longitudinal axes of said tungsten carbide masses.

34. A method of any one of claims 8 to 33 which said component is a wear tip and said iron containing material is a nickel chromium alloy cast iron.

35. A method of any one of claims 8 to 33 wherein said component is a backup tip (see US Patent 4586663 as to the distinction between wear tips and backup tips) and the iron containing material is spheroidal graphite iron.

36. A method of any one of claims 8 to 35 wherein the iron containing material is more ductile than the tungsten carbide mass(es) and less brittle.

37. A sacrificial component produced by a method of any one of the preceding claims.

38. A mineral breaker including a sacrificial component as claimed in claim 37.

39. A wear tip or back up tip for a mineral breaker having at least one hard transition metal carbide shaped body at least substantially fully embedded by casting a metal matrix (preferably S.G. Iron or Nihard or High Chromium Iron about the body or bodies) as a metal carrier for the carbide body or bodies and adapted, by virtue of its to be mounted position with respect to the loci of mineral piece movement to erode in part to reveal a sacrificial surface area of the carbide body or bodies to subsequently be eroded by mineral pieces in use.

40. A tip of claim 39 wherein said metal matrix is of spheroidal graphite iron or high chromium iron.
**INTERNATIONAL SEARCH REPORT**

**International application No.**
PCT/NZ00/00094

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### A. CLASSIFICATION OF SUBJECT MATTER

**Int. Cl.**: B02C 007/11, 007/08, B22D 019/04, 019/16

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

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### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC³ AS ABOVE

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)

Derwent WPAT. IPC³ (B02C 007/11, 007/08 & +plate+) & (B22D 019/- & carbide+ or ceramic+ & Cermet+)

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### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 5383513 A (Revanker) 24 January 1995 Whole Document</td>
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[X] Further documents are listed in the continuation of Box C  [X] See patent family annex

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**Date of the actual completion of the international search**
18 August 2000

**Date of mailing of the international search report**
31 AUG 2000

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