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LUBRICANT FOR USE IN THE HOT EXTRUSION OF METALS AND METAL ALLOYS

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9 Claims. (Cl. 252—28)

This invention has reference to a lubricant for use in the hot extrusion of metals and metal alloys and is concerned more particularly with a lubricant for use in the hot extrusion of metal and metal alloys at temperatures in excess of 1000° C.

It has been proposed heretofore to use as lubricants in the hot extrusion of metals and metal alloys, graphitic materials, materials having a stable flake-like crystal structure such as molybdenum disulphide, glass and natural or synthetic slags and to apply these materials as a lubricant to the hot billet or ingot before extrusion.

The present invention has for its object to provide a new and improved lubricant for use in the hot extrusion of metals and metal alloys which can be applied to the hot billet or ingot before extrusion, which possesses a viscosity which is adequate and satisfactorily constant over a range of temeperatures suitable for a particular extrusion, which is of a relatively unform viscosity over a wider temperature range than, for example, a non-crystalline material such as glass and which is devoid of abrasive particles at extrusion temperatures in excess of 1000° C. and the basis of which is available in quantity from naturally occurring sources.

According to the invention our new and improved lubricant comprises in its composition substantially geologically unaltered basaltic rock as hereinafter defined, free of sulphur and fluorine, crushed into granular form and which has been rendered fluid by heating and subsequently subjected to a controlled rate of cooling for determining the fineness and nature of the crystalline structure so produced which is most suited to the requirements of viscosity, melting range and other properties called for by the conditions under which lubricant is required to operate for any particular extrusion and then crushed to granular form. By "controlled rate of cooling" we mean merely that the cooling is gradual as distinguished from quenching.

According to the invention also lubricant for use in the hot extrusion of metals and metal alloys consists of a substantially geologically unaltered basaltic rock having a chemical composition normally around the following mean values:

	Percent
Silica	50
Alumina	16
Iron and titanium oxides	15
Alkaline earth metal oxides	12
Alkali metal oxides	2

crushed into granular form.

According to the invention also basaltic lubricant as aforesaid is preformed into cakes or shapes for insertion in the extrusion press between the die or mandrel and the leading end of the ingot or billet to be extruded prior to extrusion.

According to the invention also lubricant for use in the hot extrusion of metals and metal alloys consists of substantially geologically unaltered basaltic rock, as hereafter defined, free of sulphur and fluorine, crushed to granular form and an additive consisting of a material having a

lower melting point than basalt and acting as a more readily moldable carrier to feed the basalt particles in a controlled manner into the extrusion die orifice and which is not harmful to the metallic mass proposed to be extruded with the aid of the lubricant and which possesses the property of at least partial liquid miscibility with the selected basalt.

According to the invention also our novel lubricant for use in the hot extrusion of metals and metal alloys may take the form of substantially geologically unaltered basalt rock which is free of sulphur and fluorine and crushed to granular form and which has been rendered fluid by heating and subsequently subjected to a controlled rate of cooling for determining the ultimate fineness and nature of the crystalline mineralogical structure so produced which is most suited to the requirements of viscosity, melting range and other properties called for by the conditions under which the lubricant is required to operate for any particular extrusion and to which there has been added prior to the partial or full melting a substance or mixture of substances which is or are not harmful to the metal or metal alloy proposed to be extruded with the aid of a lubricant and which possesses or possess the property of complete or partial liquid miscibility with the selected basalt, the resultant product being re-crushed into granular form.

According to the invention also our novel lubricant for use in the hot extrusion of metals or metal alloys may take the form substantially geologically unaltered basalt rock crushed to granular form and from which sulphur and/or fluorine-bearing minerals are absent or have been removed in a case where it is known that these elements would have a harmful effect on the metal or metal alloy it is intended to extrude with the aid of the lubricant and which has been partially or fully melted and subsequently subjected to gradual cooling for determining the ultimate mineralogical structure most suited to the requirements of viscosity, melting range and other properties called for by the conditions under which the lubricant is required to operate for any particular extrusion and then crushed into granular form and an additive in powder form which is not harmful to the metal or metal alloys proposed to be extruded with the aid of a lubricant and which possesses the property of complete or partial liquid miscibility with the selected basalt and which is introduced into the crushed product after treatment as aforesaid.

The invention also consists of lubricants for use in the hot extrusion of metal and metal alloys comprising geologically unaltered basalt rock from which sulphur and/or fluorine-bearing minerals are absent or have been removed in a case where it is known that these elements would have a harmful effect on the metal or metal alloy it is intended to extrude with the aid of the lubricant and an additive which is not harmful to the metal or metal alloy proposed to be extruded with the aid of a lubricant and which possesses the property of complete or partial liquid miscibility with the selected basalt and which is preformed into cakes or shapes for insertion in the extrusion press between the die or mandrel and the leading end of the ingot or billet to be extruded prior to extrusion.

The invention still further consists in lubricants for use in the extrusion of hot metals and metal alloys substantially as will be described hereinafter.

The invention yet further includes in its scope the novel process of using in the extrusion the novel hot metals and metal alloys of lubricant produced substantially as will be described hereinafter.

The basis of the lubricant is a substantially geologically unaltered basaltic rock, that is to say, basaltic rock in the original state in which it solidified and crystallized from the molten magma and which has not been converted to any appreciable extent to secondary minerals as

by recrystallization or weather in the geological ages since its original solidification and containing as the main mineralogical constituents olivine, augite, plagioclase, with dispersed magnetite, together with a limited amount of titanium magnetite or ilmenite and a minimum of zeolites and other low melting point and hydrous constituents. In a case where it is known that sulphur or fluorine are harmful to the metal or metal alloy which it is intended to extrude with the aid of the lubricant the selected basaltic rock preferably should be one free from sulphur or fluorine-bearing minerals although if such elements are present in a selected raw material such sulphur and fluorine-bearing minerals may be removed by known processes.

The basaltic rock is crushed into granular form and may be applied either by spreading the granulated crushed lubricant on a bed onto which the hot ingot or billet is deposited and rolled preparatory to extrusion whereby the hot ingot or billet is caused to be coated with the lubricant, or alternatively, the granular lubricant may be sprinkled on to the hot ingot or billet.

Preferably the selected basaltic rock is crushed to a granular form and then partially or fully melted and subsequently subjected to gradual or controlled cooling to determine the fineness and nature of the crystalline structure so produced which is most suited to the particular requirements of viscosity, melting range and other properties required by a lubricant for the specific extrusion application for which it is intended to be employed, the treated intermediate product being crushed into granular form for application to the hot ingot or billet in the manner aforementioned or preformed into cakes or shapes which may be inserted in the extrusion press between the die or mandrel and the leading end of the hot ingot or billet to be extruded, prior to extrusion.

Basaltic lubricants as hereinbefore described have been found useful for the extrusion of nickel alloys since these alloys are customarily extruded relatively slowly and at a relatively high temperature so that there is ample opportunity for the basaltic lubricant to soften and fuse during the extrusion operation so as to maintain a continuous lubricant film as the hot ingot or billet is forced through the die.

In the illustrative but non-limiting example for use in the extrusion of a nickel alloy containing essentially 80% by weight nickel and 20% chromium and which is required to be extruded at a temperature between 1100° C. and 1150° C. dependent upon the variations of size of the billet extrusion ratio and the type of extruded section, a suitable lubricant is prepared by crushing substantially geologically unaltered basaltic rock, as hereinbefore defined, heating the crushed mass to a temperature of 1250° C. to render the crushed mass fluid then casting the fluid mass into a mold and allowing the mass to cool at a rate of 100° C. per hour and then re-crushing the cooled cast mass into granular form.

It may be experienced, however, that in the case of "steels," where it is customary practice to extrude at a somewhat lower temperature and at a faster rate than as practised for nickel alloys, the required rate of extrusion may be such that the basaltic lubricant is afforded insufficient time to soften and flow as a continuous film on the surface of the ingot or billet during extrusion, in which case the surface finish of the extruded product may be impaired. For use where such circumstances may arise the lubricant may conveniently have admixed therewith an additive in powder form consisting of one or more substances which possess the property of complete or partial miscibility with the basaltic material and which are not harmful to the "steels" required to be extruded and which have the effect of occasioning the softening and fusing of the basaltic lubricant during extrusion, said additive having a lower melting point than basalt and so acting as a more easily moldable carrier to feed the basalt particles in a controlled manner into the extrusion die orifice.

Convenient additives for this purpose include: sodium silicate; sodium carbonate; sodium borate; boric anhydride; calcium fluoride; ferrous silicate; calcium oxide; magnetite.

The additive may be applied to the crushed granular lubricant prior to application to the hot ingot or billet as first described, or to the crushed granular lubricant after partial or full melting and controlled cooling or subsequent to a partial or full melting and controlled cooling and re-crushing, or in the case where the lubricant is to be preformed into cakes or shapes before the formation into cakes or shapes takes place.

In practice it is found that the additive either as a single substance or mixtures of two or more substances need not normally exceed 25% by weight of the extrusion lubricant to produce satisfactory results, and in some cases may be as low as one percent by weight of the said extrusion lubricant.

Chemically the composition of the lubricant is of less significance than the mineralogical constitution, that is the fineness and crystalline nature, which is the dominant factor in establishing the physical characteristics of the material as a lubricant in the extrusion process.

During extrusion the applied lubricant passes through the die together with the hot billet or ingot as it is being extruded and exercises lubrication beneficial to extrusion. The extrusion product may be freed from any residual lubricant by pickling in any relatively inexpensive pickling medium such as sulphuric acid or hydrochloric acid.

It is found that basaltic lubricant as hereinbefore described has a viscosity adequate and satisfactorily constant over a range of temperature suitable for a particular extrusion operation, is of uniform composition and devoid of abrasive or other solid particles at extrusion temperatures in excess of 1000° C.

It may be remarked that the basaltic lubricant of the present invention is superior to glass as a lubricant and which material may be considered in this context as being closest to the lubricant of the invention since:

(1) The melting process of basalt is controlled by its crystalline nature to give a more uniform viscosity over a wider temperature range than is the case with a glass which is noncrystalline.

(2) The melting range can be easily adjusted by the additions specified to suit the actual extrusion temperatures employed for the metal to be extruded.

(3) The residual film of lubricant adhering to the surface of the extrusion is more easily removed in the case of basalt for two reasons:

(*a*) The basalt tends to flake off spontaneously on cooling, possibly due to a sudden and appreciable volume change in the solid basalt as its cools below a red heat. Glass normally adheres firmly on cooling.

(*b*) Glass requires a hydrofluoric acid pickle for its removal. The residues of basalt are readily removed by a more simple sulphuric or hydrochloric acid pickle, which avoids the hazards and dangers of handling and disposing of hydrofluoric acid.

We claim:

1. A lubricant for use in the hot extrusion of metals and metal alloys, consisting of a crushed substantially geologically unaltered basaltic rock which has been first crushed, then rendered fluid by heat, subsequently subjected to controlled cooling and then crushed into granular form and which has a chemical composition normally around the following mean values:

	Percent
Silica	50
Alumina	16
Iron and titanium oxides	15
Alkaline earth metal oxides	12
Alkali metal oxides	2

2. A lubricant as described in claim 1, further characterized in that it includes an additive selected from the group consisting of the following substances: sodium silicate; sodium carbonate; sodium borate; boric anhydride; calcium fluoride; ferrous silicate.

3. A lubricant for use in the hot extrusion of metals and metal alloys, comprising as its major component in an amount of not less than 75% by weight substantially geologically unaltered basaltic rock in granular form and being free of sulphur and fluorine-bearing minerals and which has been subjected to crushing, fluidizing by melting, controlled cooling and final crushing.

4. A lubricant for use in the hot extrusion of metals and metal alloys, comprising as its major component in an amount of not less than 75% by weight substantially geologically unaltered basaltic rock in granular form and which has been at least partially melted and subsequently subjected to controlled cooling for determining the fineness and nature of its crystalline structure.

5. The process of making a lubricant for use in the hot extrusion of metals and metal alloys, comprising the steps of crushing basaltic rock which is free of sulphur and fluorine and substantially geologically unaltered to granular form, rendering the crushed rock fluid by heating, and subsequently subjecting the fluid rock to a controlled rate of cooling and thereby determining the ultimate fineness and nature of its crystalline structure as well as the melting range and viscosity of the resulting lubricant.

6. The process of making a lubricant for use in the hot extrusion of metals and metal alloys as described in claim 5, further characterized by the step of adding to the crushed rock, prior to its being rendered fluid by heating, an additive selected from the group consisting of sodium silicate, sodium carbonate, sodium borate, boric anhydride, calcium fluoride and ferrous silicate in an amount approximately one to 25% by weight of the lubricant, having a lower melting point than basalt, acting as a more easily meltable carrier in feeding the basaltic particles into the extrusion die and which possesses the property of at least partial miscibility with the basalt.

7. A lubricant for use in the hot extrusion of metals and metal alloys, consisting of substantially geologically unaltered basaltic rock, free of sulphur and fluorine and in granular form, together with an additive selected from the group consisting of sodium silicate, sodium carbonate, sodium borate, boric anhydride, calcium fluoride and ferrous silicate having a lower melting point than basalt in an amount approximately one to 25% by weight of the lurbicant, and acting as a more easily meltable carrier to feed the basalt particles in a controlled manner into the extrusion die orifice, the said additive being harmless to the metallic mass proposed to be extruded with the aid of the lubricant and possessing the property of at least partial miscibility with the selected basalt.

8. In a process of extruding metals and metal alloys, the step of applying the lubricant described in claim 7 by rolling a hot metallic mass on a granular bed of the lubricant preparatory to extrusion.

9. In a process of extruding metals and metal alloys, the step of applying the lubricant described in claim 7 by sprinkling it in powdered form upon a hot ingot preparatory to extrusion.

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