United States Patent Office 2,882,589 Patented Apr. 21, 1959

2,882,589

LUBRICANT IN POWDER METALLURGY

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No Drawing. Application May 10, 1954
Serial No. 428,848

2 Claims. (Cl. 29—182)

This invention relates to lubricants in powder metallurgy and more particularly it relates to the preparation and use of zinc soaps as lubricants in the molding of metal powders. Still more particularly it relates to zinc soaps having specific physical properties for use as a metal powder molding lubricant having specific physical properties.

In the fabrication of metal objects from metal powders it is common practice to add a small amount of a lubricant to the metal powder. The addition of this lubricant improves the flowability of the powder into intricate molds and increases the density of the finished piece by permitting closer packing of the powder under pressure. At the same time, wear on the die is reduced to a minimum, resulting in longer die life, and the finished pieces are easily ejected from the mold without breakage.

After ejection from the die the molded piece must be sintered, usually in a reducing atmosphere, in order that it may be unified into a strong coherent whole.

To be acceptable, a metal powder lubricant must give good performance in regard to three particular characteristics. First, the melting point of a lubricant must be high enough to prevent melting at the temperature reached when the powder is subjected to high pressures. If the lubricant melts, it will cause adherence of extraneous powder after compacting and result in a faulty piece on sintering.

Second, the pressure necessary to eject the compact from the die after pressing must be low enough to avoid breaking the compact. A low ejection pressure is thus highly desirable.

Third, the lubricant must not deposit carbon on or in the piece in the sintering oven. Too much soot imparts a dull, black appearance to the piece. Furthermore, carbon may impair the mechanical properties of the impact and may also be chemically objectionable.

These three criteria then, by and large, control the desirability of a lubricant in powder metallurgy. In addition to the three criteria listed above, the lubricant, of course, should also meet the usual commercial specifications as to cheapness, ease of handling, non-toxicity, etc.

Zinc stearate has found wide acceptance in the powdered metal industry because it possesses those characteristics which define an excellent lubricant.

The commercial zinc stearate used in the past as a lubricant in powder metallurgy has been satisfactory. However, the various commercial zinc stearates on the market do not possess all the above-described desirable three characteristics to any great extent. One zinc stearate may have an excellent melting point and may have characteristics that allow a low ejection pressure, yet it causes some sooting during the sintering step. Another zinc stearate may be excellent as far as sooting is concerned and yet it demands too high an ejection pressure.

It is an object of the present invention to supply a zinc stearate lubricant that possesses the three desirable characteristics to a high degree. It is a further object to

supply a zinc stearate metal powder lubricant which is cheap, easy to handle, non-toxic, and which may be used in smaller quantities than heretofore possible.

Surprisingly it has been found that the particle size of the zinc stearate lubricant exerts an extraordinarily large effect on the properties of the lubricant. Thus the objects of the present invention are met by a zinc stearate powder in which at least about 50% of the powder particles are in the size range of about 0.10–0.60 micron.

The zinc stearate molding lubricant of the present invention may be prepared in the usual zinc stearate manufacturing processes so long as the stearic acid from which the zinc stearate is made is better than about 90% pure; it should not contain large quantities of palmitic and myristic acids. Otherwise a commercial zinc stearate having most of the particles in the size range of about 0.5–1.5 microns will be produced.

It has been customary in the past to add from 1–3% of zinc stearate to the metal powder. However, the zinc stearate lubricant of the present invention need not be added in a quantity as high as 3%. It has been found in practice that about 0.5% suffices to accomplish without sacrifice of performance the three desirable criteria outlined earlier. Thus an outstanding advantage of the lubricant of the present invention is that a smaller amount is required as opposed to that required in the past.

Although improved properties in the zinc stearate lubricant are obtained where at least about 50% of the powder particles are in the size range of about 0.10–0.60 micron, even better results are obtained when about 75% of the particles meet the size limitations. Outstanding results become apparent once about 50% of the particles are in the proper size range. These results continue to improve as a greater proportion of the particles fall inside the desirable size range until about 75% of the particles lie in the range. It is indicated that proportions greater than 75% will also yield highly desirable results but the difficulty of preparing a zinc stearate lubricant having a proportion higher than about 75% begins to outweigh the advantages derived from such a powder. Thus the lubricant of the present invention may be broadly defined as having at least 50% of the particles in the proper size range, and more narrowly defined as having about 50–75% of its particles in this range.

The superior results of the zinc stearate lubricants of the present invention are readily apparent when contrasted with the usual commercial zinc stearate lubricants. Comparisons have been made of three zinc stearate lubricants. The first zinc stearate lubricant contained more than 50% of the powder particles in a size range greater than about 1.8 microns. The second zinc stearate lubricant contained more than about 50% of the powder particles in a size range of about 0.5–1.5 microns. The third zinc stearate lubricant, that of the present invention, contained more than about 50% of the powder particles in the size range of 0.10–0.60 micron.

The first zinc stearate lubricant containing the largest particles had a satisfactory melting point but it required a high ejection pressure in order to remove the molded piece from the die. Furthermore, on sintering, the molded piece developed a sooty appearance on the surface. These unsatisfactory properties could be diminished to some extent by utilizing a higher proportion, that is about 5%, of the lubricant but sooting increased when this was done.

The second zinc stearate lubricant containing a major proportion of particles in the size range of about 1 micron had a satisfactory melting point and a lower ejection pressure than did the first. However, carbon deposition was still apparent on the surface of the molded piece after sintering. At a concentration of about 3% by

weight of the powdered metal this lubricant was satisfactory except that the finished piece presented a spotty appearance.

The third zinc stearate lubricant containing a major proportion of powder particles in the size range of about 0.10–0.60 micron had a satisfactory melting point. In addition, it had the lowest ejection pressure of all lubricants tested. Furthermore, the surface of the piece after sintering presented a clear and bright appearance with no sign whatsoever of carbon deposition. These beneficial results obtained even when the amount of the lubricant had been reduced to 0.5% by weight of the metal powder.

The lubricant of the present invention may be utilized in the molding of various metal powders such as copper and copper base alloys, iron, aluminum and other metals.

I claim:

1. A molding composition consisting essentially of powdered metal and from about 0.5% to about 3.0% by weight of said metal of a zinc stearate powder in which at least 50% by weight of the zinc stearate powder particles are in the size range of about 0.10–0.60 micron, said zinc stearate having been prepared from stearic acid of better than about 90 percent purity.

2. A composition according to claim 1 in which from 50% to about 75% of said zinc stearate powder particles are in the size range of about 0.10–0.60 micron.

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