

# ALIEN PROPERTY CUSTODIAN

## PROCESS FOR HARDENING FILES

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Our present invention relates to an improved process for, and composition for use in hardening files.

In order to harden files, which in general have a carbon content of between 0.5 and 1.5%, the files are generally heated in baths of fused lead to relatively high temperatures, for example temperatures of about 800° C. and the files are thereupon quenched for example by introducing them into brine. In this process the files are coated prior to the heat treatment with a protective layer for preventing decarbonisation and undesired deposition of lead.

It is an object of the present invention to provide suitable baths of fused salts for the heat treatment of files, instead of lead baths which give off vapours injurious to health at the necessary high temperatures and moreover have further disadvantages.

Experiments which have been made with a view to solving this problem by means of fused salt bath, which contained alkali cyanides as agents for preventing decarbonisation, have shown that it is not possible to employ known cyanide-containing fused salts, which are suitable for the heat treatment of metals, for the heat treatment of files which it is desired to harden. This will be understood when it is considered that it is a matter of objects with roughened or toothed surfaces which must combine a plurality of important properties, such as hardness, gripping power, resistance to breakage, great durability etc. Experiments with fused salt baths which contained large quantities of alkali cyanides for example between 25 and 75% have proved unsuccessful. Files treated in these baths did not possess sufficient gripping power. Experiments with baths which contained small quantities of alkali cyanides in admixture with the usual inert salts, such as alkali chlorides or mixtures of alkali chlorides and alkali carbonates, also did not give technically satisfactory results. In the last mentioned case undesired decarbonisation was observed inter alia.

Further extensive experiments have led to the surprising result that files may be hardened to give excellent products, if fused baths are employed for the heat treatment which contain, as the agent preventing decarbonisation, cyanides in quantities not exceeding 25% of the total fused bath and also alkaline earth halides, preferably alkaline earth chlorides, and alkali halides, preferably alkali chlorides.

A preferred alkaline earth halide for this purpose is barium chloride, which can be employed

in large quantities without producing any undesired effects. On the other hand strontium chloride and more particularly calcium chloride may cause an undesired decomposition of the cyanide with separation of carbon.

It is accordingly advisable to employ the halides of strontium and in particular of calcium in relatively small quantities which do not cause undesired decomposition of the cyanide with separation of carbon when the heat treatment is carried out at temperatures for example of about 750-850° C.

The content of cyanide in the fused bath may for example be from about 2 to 15%, preferably about 4 to 10%. The content of barium halide may lie between about 10% and about 60%, preferably between about 30% and about 50%. Barium chloride may be employed alone or together with strontium chloride or calcium chloride or both. Suitable alkali salts are for example sodium chloride, potassium chloride or both. In suitable cases lithium chloride may also be incorporated with the fused bath as an addition which lowers the melting point.

By suitable choice of the halides and their bases, fused baths of desired low viscosity can be produced and in this way losses of material by adhesion of the fused bath to the files to be treated can be considerably reduced. The alkaline earth halides, for example barium chloride, apparently have the effect of preventing decarbonisation, counteracting undesired nitration and ensuring uniform results.

The following composition may be mentioned as an example of a fused bath according to the invention:

*Example*

	Parts
Barium chloride .....	50
Sodium chloride .....	20
Potassium chloride .....	30
Sodium cyanide .....	4-8

The content of cyanide, which diminishes in the course of working with the bath, is preferably maintained within suitable limits for example by periodic addition of fresh cyanide. The baths cannot be maintained for any considerable period in a condition suitable for operation simply by replacement of the cyanide used up. In fact if the content of alkaline earth halide falls below a certain limit, the effectiveness of the bath deteriorates. Hence provision must also be made for the replacement of the alkaline earth halide, especially when the effectiveness of the fused

baths diminishes. When the baths are employed for a considerable period their composition varies through formation of carbonate, for example sodium carbonate, which may reduce the effectiveness of the fused bath when the carbonate content increases above certain limits, especially if at the same time the alkaline earth halide content of the bath has diminished. In general it is therefore advisable to replace the baths from time to time by fresh additions.

Extensive practical experiments have shown that the lead baths previously employed can be completely replaced by the employment of baths

which contain limited quantities of cyanide together with alkaline earth halide and alkali halide. Files are obtained in uniform yield of excellent hardness. A particular advantage of the process also consists in that it is extremely suitable for hardening files in series.

The application of protective layers, as was customary in the previously usual heat treatment of files in lead baths, may be omitted when working according to the above process.

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