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HPHT Sintering of Dual Bits

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Abstract – Dual bits have gained wide commercial acceptance in oil and gas drilling due to their high rates of penetration, long life and mechanical simplicity. Machinery industry has also recognized its success. However, those bits have had limited success at drilling high compressive strength and abrasive rock formations due to intrinsic characteristics. The progressive improvement of drilling and machining tools equipped with these elements depends on novel technologies that could probably minimize some of dual bits disadvantages.

The present work comprises a study about the possibility of obtaining dual bit diamond inserts through the novel method of sintering both layers, diamond table and hard metal support, at the same time. The main application for this kind of insert is the drill bit industry of oil and gas exploration. In Brazil, this is the only kind of material applied for that purpose.

The possibility of obtainment of dual bit inserts is to be tested through the sintering of a diamond layer (table) over a hard metal support (WC+15w.%Co) under conditions of 5.0 to 7.7 GPa of pressure and 1400 to 1600º C of temperature, in a thoroidal type anvil high pressure device with a 13.5 mm central concavity, making use of a 630-ton special press [1]. The sintering conditions were imposed in two ways: directly or with pre-heating and pre-compaction, the so called pre-sintering. The formation of the cutting layer is due to the infiltration of the liquid solution of Co+W, coming from the hard metal support, in the diamond crystal skeleton.

As the samples were obtained via different parameters, they were cleaned and tested by measuring microhardness, wear resistance coefficient, densification, and SEM. The results of the tests have shown the possibility of obtaining good quality inserts by sintering both layers of compacted powder.

The novel method, here presented, is also related with another innovation: the application of pre-sintering with relatively low parameters which allows one to obtain samples with higher densification, hardness, and wear resistance. Higher parameters of sintering are also contributing to the improvement of the samples, as it promotes better adhesion between the diamond particles and between the two layers (diamond table and support) of the composite (Figure 1).

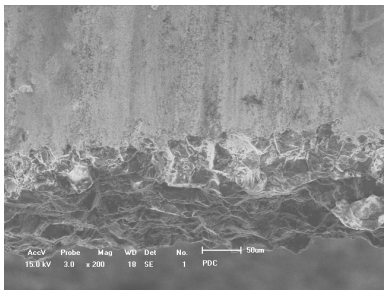

Figure 1: Great adhesion between diamond crystals and hard metal support. Wear surface of a sample pre-sintered (4.0 GPa and 700° C) and sintered at 5.0 GPa and 1600° C.

References

[1] L. F. Verestshagin and L. G. Khvostantsev, High Pressure Producing Apparatus, US Patent 3854854 (1974).