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AN INVESTIGATION INTO IMPROVING THE SPALL RESISTANCE OF POLYCRYSTALLINE DIAMOND COMPACTS

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Abstract

An investigation of polycrystalline diamond compact (PDC) cutter failures, which are industrially known as spalling, was conducted by exploring changes in the diamond layer architecture and edge geometry of the cutter. Layer architecture was investigated through the use of layered functionally graded (FG) structures. Twenty one FG variations were prepared by the tape casting method and sintered using a high-pressure, high-temperature press.

The vertical borer test (VBX), a laboratory test method, was used to gauge the improvement in spall resistance of the FG specimens against the benchmarks. Due to cost constraints associated with VBX testing, of the 21 available specimens, only four variations were tested for spalling. Contrary to expectation, it was found that all four specimens spalled during VBX testing despite showing a slight improvement in the spall area. For this reason, this route was abandoned. It was concluded that the use of layered structures is not effective in resolving the spalling problem.

The use of novel edge geometry was investigated by taking three standard products and creating new geometric profiles on the specimens using a spark erosion machine. Each profile comprised a depression on the front face of the cutter. The specimens with novel geometry were also tested on the VBX. The spall was found to be confined between the chamfer breach and the depression feature. The depression appeared to have stopped the spall from propagating beyond the allowable spall limit of 1.2mm. On the basis of this

finding, it was concluded that spalling was successfully resolved. It is recommended that further optimization of this solution should be explored in field testing. In addition, a cost-effective way to fabricate the geometric profiles on the cutters should be further investigated because creating specimens using the spark erosion machine was quite expensive. Therefore, it is not viable for fabrication of large production volumes.