

Effect of Microstructure on Wear Resistance of Polycrystalline Diamond Composite Cutter of Bit

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Abstract : Polycrystalline diamond composite (PDC) cutter is made of diamond powder as raw material, cobalt metal or non-metallic elements as a binder, mixed with WC cemented carbide matrix assembly, through high temperature and high-pressure sintering. PDC bits with PDC cutters are widely used in oil and gas drilling because of their high hardness, good wear resistance and excellent impact toughness. And PDC cutter is the main cutting tool of bit, which seriously affects the service of the PDC bit. The wear resistance of the PDC cutter is measured by cutting granite with a vertical turret lathe (VTL). This experiment can achieve long-distance cutting to obtain the relationship between the wear resistance of the PDC cutter and cutting distance, which is more closely to the real drilling situation. Load cell and 3D optical profiler were used to obtain the value of cutting forces and wear area, respectively, which can also characterize the damage and wear of the PDC cutter. PDC cutters were cut via electrical discharge machining (EDM) and then flattened and polished. A scanning electron microscope (SEM) was used to observe the distribution of binder cobalt and the size of diamond particles in a diamond PDC cutter. The cutting experimental results show that the wear area of the PDC cutter has a good linear relationship with the cutting distance. Simultaneously, the larger the wear area is and the greater the cutting forces are required to maintain the same cutting state. The size and distribution of diamond particles in the polycrystalline diamond layer have a great influence on the wear resistance of the diamond layer. And PDC cutter with fine diamond grains shows more wear resistance than that with coarse grains. The deep leaching process is helpful to reduce the effect of binder cobalt on the wear resistance of the polycrystalline diamond layer. The experimental study can provide an important basis for the application of PDC cutters in oil and gas drilling.

Keywords : polycrystalline diamond compact, scanning electron microscope, wear resistance, cutting distance

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