Reducing Copper & Aluminum Waste in Power Cable Production

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The compacting dies can mean the difference between good and bad stranding machine performance.

Nano-Diamond America, Inc. supplies small pieces of equipment that look completely insignificant beside a rigid strander or a bow strander, either of which may weigh many tons and occupy pride of place on the factory floor. Our equipment doesn't even rotate—it just sort of sits there in a stranding machine without even moving. But the compacting dies installed in a strander of any type can mean the difference between brilliant and awful performance of the machine in its primary role—manufacturing the precious conductor body forming the heart of any power cable.

First, a brief word about the very progressive design of the best modern rigid stranders. They incorporate the highest of high technology in the form of the latest digital speed and positional control systems. The purpose is to ensure that every individual conductor is delivered to the relevant compacting die in perfect condition, free of surface damage and free from internal stress damage.

Why go to all this trouble and expense? The answer is simple—the designers of these wonderful machines know the importance of using copper and aluminum with maximum efficiency. They know that damage to the conductors may be visible, or it may lie hidden beneath the surface. They know that every time a conductor is damaged, its electrical resistance increases. And that simple fact means that more copper or aluminum will be needed to make the conductor body and ensure that the cable passes the DC electrical resistance test. Copper and aluminum are the most expensive components of any cable and it repays the cable manufacturer handsomely to be frugal in the use of both of these metals.

So the individual conductors are delivered with tender, loving care to the compacting die of each layer of the conductor body. What follows in the next fraction of a second is a process of enormous complexity, possessing a real element of uncertainty. The conductors are pulled through the die and they are deformed in the process of being compacted, causing inevitable damage. This may be significant damage or it may be minimal damage. For reasons already stated, what you want is minimal damage, of course.

The Need for Lower-Friction Compacting Dies

Here is something that every cable designer knows well: If you want to make cables that use less copper and aluminum, then you must search for compacting dies which have lower friction. This is by no means the only thing you must do, but in all the multitude of variables confronting the cable designer, this is the great fact that does not change.

But isn't this a solved problem? Cable designers are already highly familiar with tungsten-carbide dies. These are inexpensive, but they rapidly go out of tolerance and they do not possess the precious low-friction characteristic that will enable copper and aluminum to be saved.

Quickly summarizing what is already well known, PCD dies last longer than tungsten-carbide dies, they hold tolerance much longer and they have lower friction. It is true that PCD dies are extremely expensive, especially in the large diameters required for compacting power cables. But the largest PCD die is still much too small for the largest power cables.

Anyways, cable designers are able to choose between these two types of dies and many have chosen PCD dies, given the enormous dollar savings achievable in copper and aluminum utilization, compared with using tungsten-carbide dies. Until recently, PCD dies were frequently the best choice.

A Third Alternative

There is now a third choice called Nano-Dies®, which have even lower friction than PCD dies (seen in **Figure 1**). They are also much less expensive than PCD dies. Nano-Dies hold a +0 tolerance throughout their long life (500 to 800 km of cable compacted). Nano-Dies deliver all the benefits of PCD dies and much more. Here lies the key to saving a lot of copper and aluminum that is still unavoidably being given away, even when the world's best PCD dies are used.

Fig. 1 — Cable compacting Nano-Die.

As well as having the lowest friction coefficient, Nano-Dies possess two additional advantages for cable designers, which are beyond the capabilities of PCD dies.

- Nano-Dies are readily available up to 60.0 mm diameter (larger on request), delivering the enormous benefit of extremely low friction at all compacting diameters.
- The surface of Nano-Dies is all diamond (no filler material). Hence, the surface quality does not deteriorate over time. Nano-Dies require no service.

The surface of a Nano-Die is pure nanocrystalline diamond, about three-and-half to four times harder than a PCD die surface. **Figure 2** shows pictures of die surfaces, each magnified 4000 times in a scanning electron microscope.

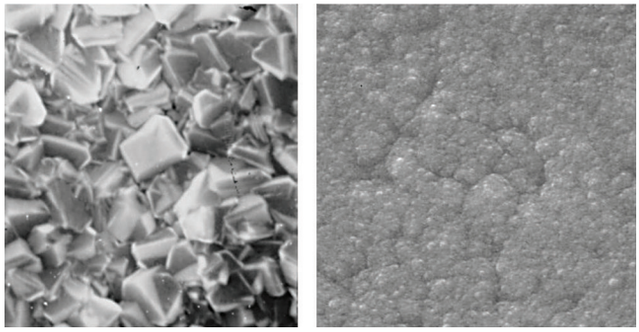

Fig. 2 — PCD surface (4000 times magnification) (left) and Nanocrystalline Diamond surface (4000 times magnification) (right).

It is fairly obvious why the Nano-Die surface has lower friction than the PCD die surface.

More information about Nano-Dies including a product video is readily available at the website listed below.

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Company Profile:

Nano-Diamond America, Inc. *supplies innovative and long-lasting tooling for industrial applications. Nanocrystalline diamond composites are used to achieve significant productivity improvements over traditional diamond tooling. Nano-Diamond America's mission is simple—to make these high-performance and very attractively priced products readily available in world markets. The major market segments in which the company operates are the wire industry, the energy cable industry and the tube manufacturing industry. Nano-Diamond America's main product is Nano-Dies. Nano-Dies are hard at work in every industrial region of the world, conserving raw material, providing better surface finishes, extending tooling life and reducing tooling costs.*

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