



High quality nylon in mobile cranes

PLASTICS IN THE
CONSTRUCTION
MARKET

by Marc Licharz and Andreas Weidenfeld

When seeking suitable materials that need to fulfill specific functions and bring economical advantages, the design engineer can no longer ignore modern plastics. Multitudes of plastics are available for the most varied applications. Many of them are geared toward specific applications and have much better properties than the conventional material. The group of engineering plastics contains the high quality cast nylons with their modifications using fillers and additives. Deciding factors such as sliding properties, wear resistance, vibration dampening, weight and, not least of all, good machinability, have all led to making highly loaded components from cast nylon. Due to these factors, cast nylon has secured a place in mobile crane construction.

Sheaves made of cast nylon

On cranes, the wire rope is an important and highly loaded part. The safe functioning of the crane relies heavily on the wire rope's capability, and, unlike other components, the wire rope must be replaced before it fails. The working lifetime of a wire rope is a function of the contact area between the rope and the

sheave. Sheave materials with a low modulus of elasticity have a low point contact pressure which leads to longer wire rope life. For this reason, thermoplastics are considered.

The following characteristics are required from the material:

- Elasticity for extended rope life.
- High wear resistance.
- Sufficient strength even at low temperatures.
- Resistance to most weather conditions.
- Resistance to lubricants.

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These requirements are filled superbly by cast nylon. The application of sheaves made of cast nylon has proven itself for years and has clear advantages over metallic materials. The most important advantages are given below.

• **Reduction of wire rope wear** — Wire rope, which runs over metallic sheaves, has higher wear due to higher point contact pressures between the rope and the sheave. Only the outer strands of the rope come into contact with the metal sheave. The wire rope wears out due to breaks in the outer strands resulting from this point contact; this can lead to failure.

Cast nylon sheaves prevent this due to their elasticity. Not only do the outer strands of the wire rope come into contact with the sheave, but also nearly the entire surface area of the strand. This lowers the surface pressure between rope and sheave and leads to a significantly longer rope life.

• **Weight reduction** — Nylon is one-seventh the weight of steel. Because of the weight savings, the use of cast nylon sheaves can result in significant weight reduction while maintaining the same load capacity. A mobile crane with 18 sheaves can realize weight savings of over 2,000 lbs., which reduces the corresponding weight per axle. The light weight also has a positive effect on the boom and simplifies handling and installation.

• **Vibration reduction** — The good dampening properties of cast nylon reduce vibration which gets transferred from the rope to the metal sheaves to the bearings and the shafts. Cast nylon sheaves are good for the rope, the bearing and the shaft. A reduction in operational noise can also be noticed.

It should also be noted that the manufacturing process of cast nylon sheaves is much less expensive than producing steel sheaves. For those reasons, nearly all crane manufacturers use cast nylon sheaves in their cranes.



Sheaves made of cast nylon 6.



Boom head of an AC 500-1 mobile crane with sheaves made of cast nylon. (Photo courtesy of Demag Mobile Cranes GmbH.)



Wear pad made of OILAMID with steel inserts for a mobile crane boom.

Sliding parts of engineering plastics

In addition to sheaves, cast nylon has proven itself as a material for sliding parts in the telescoping booms of mobile cranes. The use of slider pads requires good sliding properties, strength, elasticity and creep resistance. The requirements are fulfilled superbly by cast nylon 6. The higher strength, in comparison to other thermoplastics, allows higher loads. The good elasticity means that the part retains its shape even after high shock loads. This eliminates any permanent deformation as long as the allowable load limits are not exceeded. Oil filled or solid lubricant filled modifications are available for highly loaded parts. A friction coefficient reduction of up to 50 percent can be realized by embedding fillers into the molecular structure. Additionally, the wear rate is reduced.

If the application is in a high moisture environment, the material PET is better suited. PET stands out due to its high mechanical strength, dimensional sta-

bility and good sliding properties. Moisture absorption is minimal and hardly affects the mechanical and electrical properties. Compared to cast nylon, PET is not as wear resistant, but there are solid lubricant filled grades of PET available. These have improved sliding properties and a significantly better wear resistance.

• **Easy fastening** — The slider pads can be fastened to the boom with a screw and a threaded hole in the pad. However, threads cut into plastics have limited strength, so highly loaded slider pads, such as those in mobile crane booms, should be fastened with special metal inserts. These inserts are pressed into stepped holes which prevent them from falling out or rotating. The underside of the pad should be flat after assembly. With such assemblies, pad thicknesses between ½"-1" are sufficient.

Special application possibilities

Specially modified materials can even be used for applications with the highest loads such as for crane float pads. The requirements for such a highly loaded and safety-related component require a material that:

- Can withstand high loads (up to 250 tons per pad).
- Can function within safety limits at high and low temperatures.
- Does not crack or shatter under load on uneven ground.
- Has shape retention (memory).
- Is wear resistant.
- Is light weight.

At first glance, these almost contradictory requirements would seem to preclude the use of plastic. All conventional plastics meet only part of the requirements. Therefore, a special material needed to be developed for this application. The basic requirements such as wear resistance, light weight and high strength were already met with cast nylon. Therefore, a mixture of caprolactam (cast nylon 6 resin) and laurilactam (cast nylon 12 resin) with an additional additive was used.

The result was the development of a material, which in addition to the nylon specific properties, has high elasticity even at the lowest temperatures and high shape retention after deformation. This nylon mixture also has lower moisture absorption and retains the required strength for this application despite the elasticity. The material has proven itself not just in short-term use and in tests but also in practical, long-term use under extreme conditions.

Conclusion

Cast nylon has proven to be extremely beneficial in mobile crane construction as well as many other applications. Its many advantages clearly make it the plastic material of choice. ■

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Outrigger float pad made of cast nylon 6/12. (Photo courtesy of Demag Mobile Cranes GmbH.)