

Roll call

OEMs AND DEALERS ALL MARKET POLYURETHANE AND RUBBER TYRES. WHICH IS BEST FOR YOUR MODEL? IT'S TIME FOR THEM TO STAND UP AND BE COUNTED...

▶ Rubber has been used in tyres for over 100 years, while polyurethanes (PU) have been used extensively for just over half that time. During the Second World War, when German scientists began searching for a synthetic rubber compound to combat supply problems, Otto Bayer discovered a material called polyurethane that would later become the workhorse of the materials handling industry.

Since that time, both substances have evolved into a highly specialised group of compounds. To better understand each material, it is necessary to comprehend that rubber and PU tyres each have strengths and weaknesses specific to their unique properties.

As a general rule, rubber tyres are used more extensively on propane and ICE lift-trucks; trucks that often operate both inside and out. In such applications, rubber is preferred for a softer ride and better traction.

Conversely, PU is limited to various electric trucks that are primarily used indoors where the floors are made of smooth concrete. Because the load capacity of PU greatly exceeds that of rubber, it is preferred in this application.

Polyurethane's chemical make-up provides a lower rolling resistance than rubber. This may not sound like an important attribute, but higher rolling resistance reduces the efficiency of any electric lift-truck. The more often a battery has to be charged, the less productive it is and the direct labour associated with handling the battery increases. As a general rule, it is always best to use a PU tyre on an electric lift-truck to minimise rolling resistance.

Rubber tyre manufacturers do produce products that are categorised as compounds specifically for electric trucks. These products are designed for lower rolling resistance to improve battery life.

The cushioning ability of a tyre is directly related to its durometer or hardness: the higher the durometer number, the harder the tyre. Rubber tyres will typically be in the range of

67-75 durometer, while PU tyres will fall between 83-95 durometer. Simply put, the softer the tyre, the more impact it can absorb. Because PU is typically harder than rubber, it is known for giving a rougher ride to the operator. One must remember that on average, rubber is about 15 durometer points softer than the softest PU compound.

If a soft ride is important to a lift-truck operator, then a rubber tyre can be used efficiently and effectively as long as the truck is not electric. If the truck is electric, then an 83 durometer PU tyre will be the softest compound recommended to maximise load capacity while minimising rolling resistance.

Polyurethane tyres are not widely available in compounds softer than 83 durometer. Softer PU durometers also quickly lose their overall toughness and load capacity. As loads have increased over the years, polyurethane manufacturers have developed compounds as hard as 95 durometer to increase performance. While these can carry considerably more load, they offer little in the way of cushioning to the operator. Many times the maintenance manager is faced with the difficult decision to sacrifice operator comfort for increased productivity that can be attained with the higher durometer PU tyre.

As a general rule, the 95 durometer polyurethane tyre will offer about 15% additional load capacity over a 83 durometer tyre. This may not sound like much, but it can mean getting the tonnage through a warehouse without the downtime from failing tyres.

Traction and load capacity

Another difference between rubber and PU can be found in each material's ability to grip the surface on which it operates. Rubber tyres will always have a softer tread surface, while PU tyres will be harder. Because rubber is softer, it will provide a broader footprint on the surface and will therefore always provide the customer with better traction than even the softest PU.

| | Rubber | Polyurethane |
|-------------------------|-----------|--------------|
| Load capacity | Good | Excellent |
| Chunk / tear resistance | Fair | Excellent |
| Abrasion resistance | Fair | Excellent |
| Traction | Excellent | Good* |
| Cushioning | Excellent | Fair |
| Rolling resistance | Good** | Excellent |
| Floor marking | Fair | Excellent |
| High-speed operation | Excellent | Good |
| Outside operation | Excellent | Fair |
| Inside operation | Good | Excellent |
| Wet floors | Excellent | Good* |

* Siped tyre will improve performance in wet applications
** Electric rubber compound

TABLE 1. Attributes of polyurethane and rubber

However, PU manufacturers have developed a process called ‘siping’ or ‘routing’ where various tread styles are machined onto the surface of the tyre. After this process, the tyres have notably better traction without sacrificing load capacity.

From a capacity standpoint, a PU tyre will carry twice the load of a rubber tyre. For this reason alone, lift-truck manufacturers have preferred PU for load wheels and tyres. These tyres will be much more resistant to splitting, tearing, or chunking out under load, as rubber tyres have a tendency to do.

Because speeds and loads carried by all types of lift-trucks seem to have constantly increased in recent years, premature failure caused by continuous overloading seems to be the main cause of failure for both rubber and PU tyres. Overload = heat = failure. It’s just that simple, whether you are using rubber or PU.

Wear and chemicals

While rubber offers a softer ride, it will not wear as well as PU. In fact, as a general rule, the latter will outlast rubber tyres by about four times. As the rubber tyre is used, it loses fragments of its tread due to surface conditions and general abrasion. On the other hand, PU does not experience similar wear due to its overall toughness. It tends to excel under sliding abrasion while rubber performs less effectively.



ABOVE: Although available in a wide range of colours, PU tyres will not mark warehouse floors

BELOW: Siped tyres will provide much better traction than plain PU tyres without sacrificing load capacity

Due to its overall toughness, the PU tyre will withstand rough floor conditions and debris much better than rubber, which does not exhibit high cut/tear strengths. Once torn or cut, the cut or tear area will propagate in a rubber tyre. Polyurethane, on the other hand, is resistant to both cutting and tearing. In fact, the items that would normally cut and tear a rubber tyre will become embedded in the PU tread without causing it to cut or tear. However, it should be noted that the cutting and tearing of both rubber and PU ultimately reduces the life of each compound.

Another comparison between the two types of tyre can be made in the area of chemical resistance. As an example, a rubber model exposed to solvents may tend to lose its ability to have good tear strength and chunk resistance, while the PU is unaffected after long-term exposure.

However, it should be noted that harsh solvents such as methyl ethyl ketone, methylene chloride or acids can destroy polyurethanes as well.

High speeds and marking

If polyurethane has one Achilles heel, it is heat – PU tyres do not dissipate internal heat well. As the speed of the truck is increased, the tyre becomes less desirable. ICE and propane lift-trucks generally travel too fast for PU tyres and operate outside, so a rubber tyre is the preferred choice in this application. Most electric lift trucks travel at speeds of 6-8mph, a speed range in which polyurethanes excel. Rubber dissipates heat well and will hold up in the higher-speed applications.

Even though polyurethane tyres come in a wide array of colours, the

basic chemistry used will not allow any colourant to mark warehouse floors. A PU tyre can pick up dirt from the floor and lay it back down on the coated surface, which can give the impression that it is marking the floor – dirt that has impregnated the coated surface does look like particles from the tyre.

Rubber, on the other hand, does mark floors if one is using a standard rubber compound. There are non-marking rubber products on the market that generally do not mark the floor – these tyres are typically grey in colour as they lack the carbon black additive that is the primary culprit.

Most produce areas have wet floors because the warehouse must keep the produce cool and damp during storage. This application poses some problems for electric lift-trucks: a large piece of machinery on a slippery floor is rarely a good combination. Traction therefore quickly becomes very important to the warehouse manager and the operator.

One might automatically think that rubber should be used as it will offer better traction. However, there are some PU products available that will offer almost equal traction in this type of environment. If a PU tyre is siped (small cuts across the face of the tread at an angle) it will offer increased traction without sacrificing load capacity. A rubber tyre could offer similar traction, but load capacity will be sacrificed.

Price comparisons

From a pricing standpoint, it is difficult to precisely compare PU and rubber tyres. But one can always be sure of one thing; the

polyurethane tyre will be more expensive due to raw material costs.

Conversely, rubber raw materials are much less expensive: depending on the compounds, a rubber tyre could cost 25-50% less than the PU type. As rubber tyres can be used in a wider array of applications and will always cost less, rubber will always be the most prevalent product used in the materials handling industry.

However, if the lift-truck is electric and the load requirements are high, then a PU tyre will be used, in spite of the additional costs.

Although it can cost twice as much as a rubber tyre, the polyurethane tyre can last up to four times longer.

To summarise, rubber tyres have their place on lift-trucks just as polyurethane tyres do, but the choice is dependent upon which material is best suited for the customer and the application. As a general rule, if a warehouse operator is running a fleet of electric trucks, the better product will be a PU tyre, which will help the operator increase throughput by having each truck capable of carrying more load during a given shift. With lower rolling resistance, they will offer increased battery life, and with increased overall toughness, will outlast the rubber by four times, reducing change-outs and labour costs. If a warehouse operator has a fleet of propane or ICE trucks, then rubber will be the obvious choice.

One must also realise that there are many formulations available in both PU and rubber tyres to maximise performance of each material. Each material will function effectively as long as it is applied correctly. Properly applied, each

material will do the job it is designed to do for the customer.

Future trends?

As warehousing demands more throughput and productivity, it will be critical for tyre manufactures to provide both rubber and polyurethane products that will continually reduce total operating costs for users of lift-trucks.

To achieve these types of demands, it will be incumbent on tyre manufacturers to maximise the performance of their products by improving tyre compounds and production processes.

In any industry there are always innovations that can change the business landscape, and that is also true as far as polyurethane and rubber tyres are concerned. However at this time, cast polyurethane tyres, along with various rubber compounds, will continue to dominate the market. For the immediate future, it is most likely that the existing compounds will be improved upon to help users receive increased life and load capability from those products. **ALT**