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Materials and manufacturing of a bike frame

What are the standard materials we use?

Steel

It doesn't matter what type of steel you use as they all have the same stiffness and weight, regardless of their strength. However, most quality steel frames use Chromoly. Chromoly is created by adding a little bit of chromium and molybdenum to steel product. This makes the material strong enough to thin down in the middle making the material lighter for use. Even though steel is a strong and sturdy material to use, it can also be quite heavy, thus adding more weight onto the bike. Although, a positive of using steel frames is that they are relatively easy and cheap to repair.

Titanium

Due to titanium's properties combining durability with a lower weight, it is considered one of the best choices for the frame building of a bike. Titanium alloys can be half as stiff as steel while also being half as dense, it is also very corrosion resistant giving it yet again another reason to be a good material for use. However, even though there's plenty of titanium in the world, it's still an expensive material to use. When welding titanium, it must be done in a way that shows great attention to detail to avoid contamination, and machining must be done precisely to avoid any issues with the frame.

Aluminium

Aluminium today is now the most common used material used in the manufacturing of bikes. This is because it has a lower density than steel, resulting in much lighter frames. However, because of its decreased density, it requires a larger diameter in the tubes to achieve the same level of required strength for the bike frames. Because of the larger diameter tubes, most riders claim this gives the bike the feeling of a harsher ride. Another positive to using aluminium is that it won't rust. Aluminium tends to be more expensive per pound than steel but it's still very affordable and along with its lightness and stiffness, this makes it a great choice these days for any kind of bike suspension.

Carbon Fibre

Carbon fibre is a thin and strong material mainly made up from carbon atoms. This means it is a very lightweight while also being a very strong material to use. It was first used in the space industry, as it has a very high strength to weight ratio. It's often seen in some professional road bikes due to these qualities it has. However, it can be quite expensive to use. Unlike the other metals we've spoken about, we can aim where we want to majority of the strength in carbon fibre to be. This makes carbon fibre a great choice for unconventional frames and other weird shapes, as it can be moulded more than any other metal.

What would be the best material for use?

After having a look at all the materials used in the production and manufacturing of a bike frame and comparing the pros and cons between them, for the bike frame shown I have determined the best material for use would be aluminium. Aluminium used to be the best choice for manufacturing bikes before carbon fibre came more accessible. But my reasons behind picking aluminium instead of carbon fibre for this bike as a choice of material is simple. I chose aluminium because it's a relatively cheap material to use being it's a lot cheaper than both titanium and carbon fibre, with steel being the only cheaper choice out of the four materials spoken about. Aluminium doesn't oxidize (meaning it won't rust) while steel will, this means it would be a good choice for long term bike. Aluminium is also relatively a lightweight material to use along with it being a very stiff material hence why it's used a lot in industries. Aluminium is a lighter material than steel and titanium, however it wouldn't be as light as carbon fibre, but carbon fibre is a lot more expensive and wouldn't be as suitable for the bike frame we're shown hence why aluminium seems like a better option. This means choosing aluminium instead of steel or titanium would give us a much lighter bike to work with. Today aluminium is one of the most common used materials in building a bicycle and is often the chosen material for building the bikes suspension due to the qualities mentioned of the material.

Overview

One-way aluminium bikes are made is by using the process hydroforming. This is a way of we can shape the metal. The process is done by pouring the liquid aluminium into a desired mould at an extremely high pressure, this allows the aluminium to press into the mould easily creating a specific shape with ease. This is a technique commonly used to optimise shapes for additional stiffness to without having to require any extra materials for reinforcement. Once the required tubes have been created from the moulds it's now time to join them together. This is commonly done by welding the aluminium parts together creating the shape of the bike.

TIG (Tungsten Inert Gas) welding is the most common process that manufactures use to put the bike together. TIG welding uses the same material (aluminium in this example) as the frame. This allows it to create a smooth, thick and even welding around the tubes making it look even and nicely done. Poor work with the welding can lead to uneven thickness and possibly may have gaps around the welding of the tubes. The best manufacturers in the world now have robotic welders, this allows for more precise precision making the welding as perfect as possible.

Through the use of hydroforming and with a welder, pretty much anyone can make a bike like this themselves as long as they have an understanding of what they're doing. This to me makes these processes even more amazing as you could literally make it a DIY project.

MIG (Metal Inert Gas) is another welding process in which aluminium bike frames can be made. It is a process in which an electric arc forms between a consumable wire electrode and aluminium metal heating them up, causing them to melt and joined together.

The choice I'd personally think that would be the best would be hydroforming and the TIG welding. Hydroforming can mould the specific parts with ease and then TIG welding being the most common practice for bikes in manufacturing it's an obvious choice to pick to weld the frame together. The aluminium frames will be created by using the process of hydroforming, in which the aluminium liquid was poured into the mould to create the parts desired. From this the bike could take form by welding the parts together. I chose this manufacturing process as it's quite a simple one to do and with the use of the robot technology these days it makes things a lot easier to mould the parts together with precision, this means the bike can be made with ease without much skill having to be involved. Welding the bike together this way can also be a relatively cheap solution and the process of welding it together can also be very quick so there isn't much of a wait to have your frame completely to carry on with whatever is to do next.

Summary

Why aluminium was the best choice?

This was because an aluminium frame is a choice if you want a long-lasting bike with it also be relatively cheap. The pros of using aluminium is that it won't oxidize (won't rust), it's a relatively cheap and common material. It's stiffness and properties that allow it to easily mould makes it a great choice.

What manufacturing process will we use to create the bike?

The parts of the bike will be made through the use of hydroforming. So we create the specific moulds we need (so we can basically have any shape we desire) then we pour the liquid aluminium in and under the heat and pressure the shape is made. Once all our parts are made and cooled we can then weld them together using the most popular welding process in manufacturing, TIG. This process welds the parts together very quick and can be done with precision if robots are involved. However, you can also weld the parts together yourself providing you know what you are doing but it won't be as precise.