

HYDRAULICS THROUGH HISTORY



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HYRDAULICS THROUGH HISTORY

Hydraulic power, at its core, refers to the use of fluids to manipulate and power machinery to perform tasks. This can take many forms. We might be used to seeing large construction equipment like excavators and dump trucks making use of hydraulics, but many people don't realize that something as simple as a waterwheel is considered to be related to hydraulic power, as well.

Hydraulic power has been used by various cultures and civilizations dating way back to as early as 2,000 years BCE. So how did it evolve over the years? How did the hydraulic power change over time until it became what we know it as today?

There are four main stages of hydraulics through history:

1. Origins
2. Early Technology
3. Adding Pressure
4. Introducing Oil

Let's look a little deeper into who was using technology, how they began using it, and what they were using it for.

ORIGINS

The earliest form of hydraulic power was the use of water by the Mesopotamians and ancient Egyptians. Their use of water for irrigation goes as far back as 6,000 BCE, and the introduction of water clocks has been traced back to 2,000 BCE. Even though these technologies don't resemble the hydraulic systems we recognize today, they set the groundwork for what would eventually grow to become our current technology.

How Does this Relate to Hydraulic Systems?

Water wasn't used as a tool before these primitive uses. Harnessing the power of water to first irrigate crops and later to track time symbolized a shift in how water was viewed. Once it grew past the point of simply being something that could satisfy thirst, it could be experimented with which would eventually lead to innovations that could drastically alter our capabilities as humans.

Noria Wheel

These early uses of water eventually led the Egyptians to develop what was called the Noria Wheel. This appeared around 400 BCE. This wheel is a method of gathering water from a stream (or a well). It resembles the wheel of a wagon, although much larger and wider. Buckets are hung from horizontal bars which dip into the water at the bottom the flow of the river pushes the wheel in a circle which brings the water-filled buckets to the top where they can be emptied.

EARLY TECHNOLOGY

The Greeks and Romans were known for their advancements in many aspects of civilized society, including math and science. They recognized the importance of water and invented creative and ingenious ways to provide water to areas that were not located near a reliable source.

And with the availability of water, came an increased usage of its capabilities. In fact, the word “hydraulic” is rooted in Greek.

Archimedes' Screw

This is a pump used for moving water from a low-lying area to an irrigation ditch. It was invented in ancient Egypt before 300 BCE to lift water from the Nile River. The design is fairly simple, yet effective. A pipe has a cylinder running up the middle. A spiral tube is wound along that cylinder which creates a seal along the inner wall of the pipe until it reaches its destination.

This is considered to be the oldest positive displacement pump.

Aeolipile

Hero of Alexandria was a mathematician and Engineer in Roman Egypt. He was known as a great experimenter of antiquity. His best known creation was the Aeolipile, which is widely considered the first steam-powered engine in the first century CE.

A basin which contains water is heated. This creates steam which rises through two vertical arms and is funneled into a ball held between them. The ball has two pipes, which causes the ball to rotate.

However, Hero failed to combine this technology with pistons which meant the industrial revolution would have to wait.

ADDING PRESSURE

The manipulation of water continued to evolve. It became more than just a way to water crops and skewed toward becoming a tool itself. The realization that pressurized fluid could be directed and harnessed was a major change in the way hydraulics were developed.

Blaise Pascal

Pascal was a French inventor, mathematician, and physicist. He is credited with constructing the first hydraulic pump. He posited that hydrostatic pressure was dictated by elevation difference and not the weight of the fluid. He proved this through an experiment called "Pascal's barrel experiment."

Vacuums were widely assumed to be impossible at this time. Pascal thought differently. He published the results of experiments on this subject in 1647 and 1648. They described the relationship between air pressure and fluids.

This inconsistency on the existence of a vacuum led to disagreements with other scientists, but it led to further development of hydraulic systems.

Pascal's Principle states that pressure change in a confined fluid is transmitted throughout the fluid, making it constant.

Daniel Bernoulli

Bernoulli was a Swiss physicist and mathematician. He published a book called *Hydrodynamica* in 1738 which described what became known as Bernoulli's principle: "As the speed of a moving fluid (liquid or gas) increases, the pressure within the fluid decreases."

This led to the introduction of pressurized water being used in pumps and mills.

Joseph Bramah

All of this was put together in 1760 when Joseph Bramah put Pascal's principle to work on two different-sized cylinders. The pressure exerted on the smaller cylinder was transferred to the larger cylinder. This led to an eventual patent on the hydraulic press in 1795.

This design is still the basis of many machines and hydraulic systems used to this day. Its incorporation into working culture sparked the industrial revolution.

INTRODUCING OIL

Water was used in the various forms of hydraulic systems throughout this time. The corrosive properties of water along with its fairly low boiling point created problems in the machinery. This led to the incorporating of oils to be used as an alternative.

Mineral Oil

Mineral Oil was used as the first hydraulic fluid as an alternative to water in the 1920s. It was chosen for its lubrication capabilities as well as its ability to withstand temperatures that would cause water to boil.

Base Stocks

The base stock of the fluids can vary, although mineral oil is a frequent base for many systems. Canola oil, for instance, is used in circumstances where biodegradability or an insistence on renewable resources are a concern. An alloy of sodium and potassium known as NaK-77 can be used as a base for circumstances including high temperatures or high levels of radiation.

Additional Compounds

Hydraulic fluid often contains a variety of compounds to afford it specialized capabilities. Oils, butanol, silicone, and other chemical compounds can afford hydraulic fluid a higher resistance to corrosion and erosion, as well as other capabilities.

CURRENT TECHNOLOGY

Hydraulic pumps, presses, and systems have continued to evolve. Many industries make use of hydraulics for everything from construction equipment to elevator lifts.

The basic design and concepts behind these systems remain the same, however. Pressurized fluid is manipulated in a specific way to operate a machine. The systems have been streamlined and the materials have been optimized, but the mechanics of how it works remain the same.

Hydraulics will continue to evolve as new technology emerges/ Smart systems will incorporate internet connectivity to create new affordances for actuators, pumps, and drive systems.

Available technology, machinery, and the knowledge of how to operate and repair these systems will continue to be essential to staying on top of the changes. Air & Hydraulic Equipment, Inc is available to answer any and all questions you may have on these historic and incredibly useful systems.