Japan Fluid Power Association

Water : the new power for machines !

Rebirth of "hydraulic drive" technology in our age - II

ADS by JFPA

Aqua Drive System

The new water hydraulics technology

Water, which is essential to life and livelihood
Now that we need to address environmental issues on a global scale, a technology to use water to drive machines receives a renewed attention.

What is ADS?

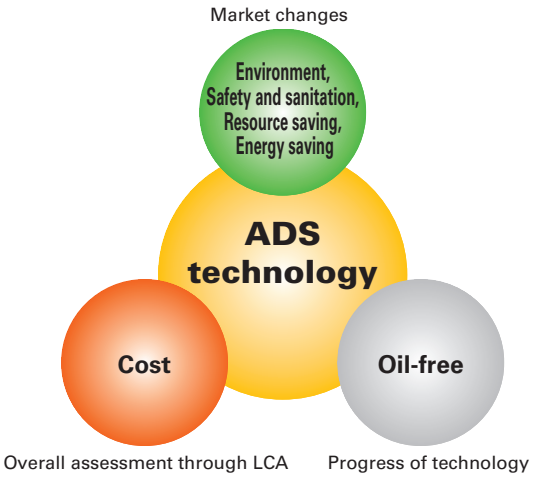
The hydraulic technology to use tap water as a pressure medium already existed in the 18th century Europe. The water hydraulic technology at that time had many issues, such as fall in efficiency due to water leakage, abrasion and friction due to the low viscosity of water, and deterioration of material from rust.

Since then, various kinds of water-based working fluid with improved rust prevention property, corrosion resistance and lubricity have been invented and used in a wide range of applications, ranging from press machines and mining machines to steel manufacturing equipments where fire risk is a major concern. Water hydraulic drive systems, generally, have so far been interpreted to represent “water hydraulics” in a broader sense to include water-based working fluids.

On the other hand, the Aqua Drive System (ADS) only uses tap water or pure water as the working fluid, unlike the conventional hydraulic drive technology.

JFPA expects that the ADS will make substantial contributions to the mechanical industry in the areas of eco-friendliness, safety, sanitation, resource saving and energy saving.
To further develop the ADS, study activities are undertaken with JFPA playing the central role on topics, such as Universal ADS (Uni-ADS) which uses the water pressure of water piping network and Steam Turbine ADS (St-ADS).

The ADS technology is not an alternative to each of the existing driving sources, such as oil hydraulic, pneumatic or electric drives.
The purpose of the ADS technology is to provide a “system solution” which enhances advantage of the system as a whole and minimizes the environmental risk.



FAQ on ADS

- **So, what is St-ADS?**

  St-ADS (steam turbine ADS) is an energy saving system that generates high-pressure water by hydraulic pumps directly connected to the turbines which are rotated with exhausted heat or excess steam in a factory.

- **So, what is Uni-ADS? What is the pressure level of the water piping network?**

  Uni-ADS (universal ADS) is a next-generation hydraulic drive system that makes use of the pressure of water piping network. The reference pressure of water piping is 0.15-0.74 MPa, and the proper pressure is 0.25-0.4 MPa.

- **So, what is ADS-Robo.?**

  ADS-Robo. (ADS robotics) means a moving element capable of two-degree-of-freedom movement that combines rotational and linear motions. It is widely used in general industrial machines and robots.

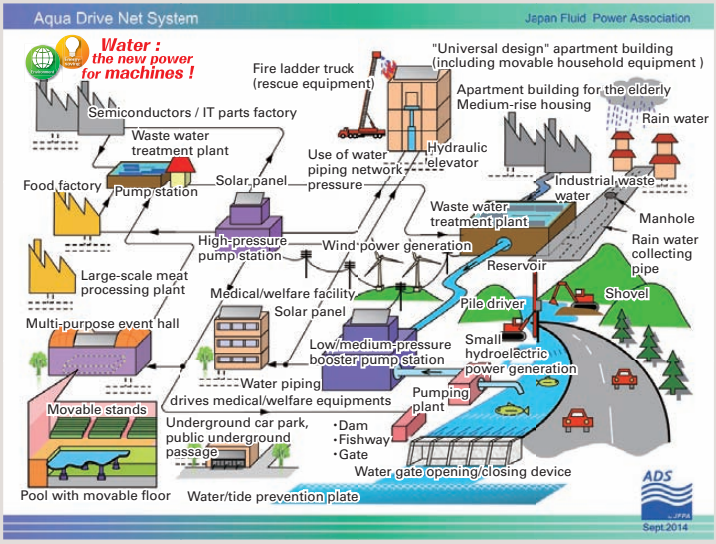
- **What are the purposes of the hydraulic system users, and how do they rate them?**

  The users judge the ADS to be most appropriate after they have comprehensively evaluated various drive systems. Hence the ADS is adopted to solve their problems.

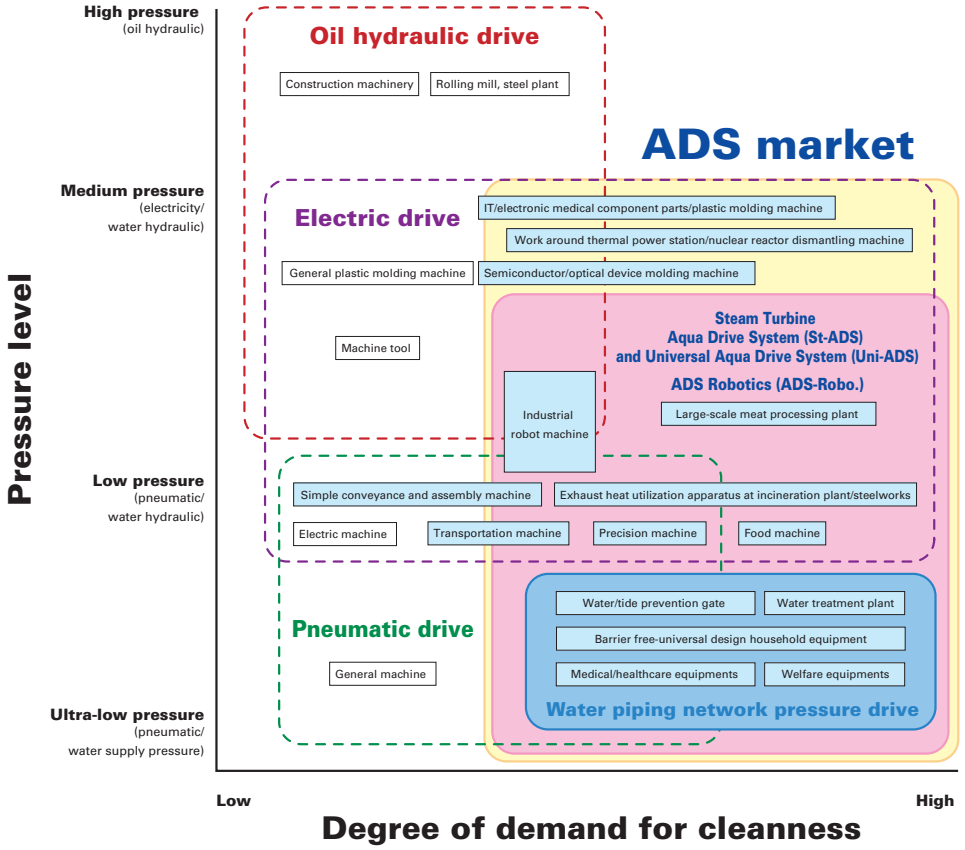
- **What are the companies that supply hydraulic equipments?**

  We have made the “Aqua Drive System (new water hydraulics) Supplier List” available.
  Please visit our website (http://www.jfpa.biz) or contact us directly.

The world of ADS and use of water - Aqua drive net system (image)



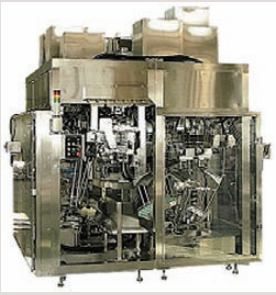
What are the ADS application areas?

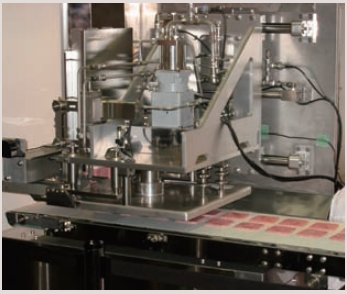


St-ADS: Steam Turbine Aqua Drive System
Uni-ADS: Universal Aqua Drive System
ADS-Robo.: ADS Robotics

ADS is used for such applictions ···

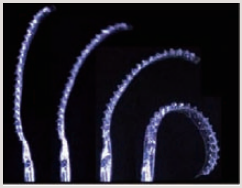
Automatic chicken breast deboner


Automatic pork shoulder deboner


Meat slicer


Hydraulic lift for bathing care


Special bathing device


Hydraulic driven catheter

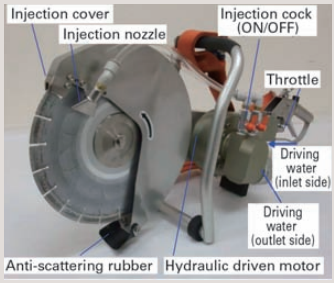

Hydraulic driven linear actuator


Endoscopic surgery assist robot


Hydraulic lifter


Water prevention plate


Hydraulic jack up robot



Fire fighting cutter driven by high-pressure water *)

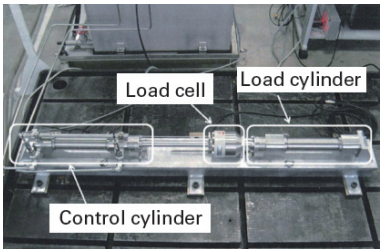
*) Tokyo Fire Department, Fire Technology Section

Green Innovation begins with ADS robotics

Servo control with linear drive system

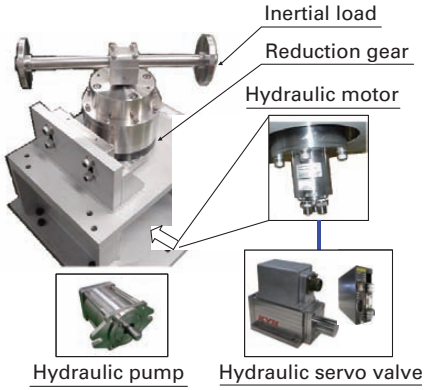
Verification experiments were conducted on a test system placed on the same straight line as the cylinder.
It was confirmed that the accuracy of hydraulic cylinder control was achieved as follows:

- Positioning accuracy: 0.1 mm
- Settling time: 4 s
- Overshoot: 0.1 mm



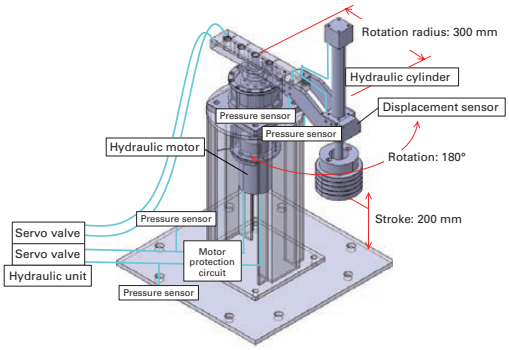
Servo control with rotational drive system

Verification experiments were conducted on the hydraulic servo control of a rotational drive system widely used in general industries. The experiments on the servo control on a rotational drive system with hydraulic motor verified the stationary error of 1°or below in step responses, a level of control allowing application in general industries.



Robotics with two degrees of freedom

Verification experiments were conducted on robotics with two degrees of freedom, combining linear and rotational motions widely used in general industrial machines.
The stationary errors of linear and rotational systems were 0.3 mm or below and 1° or below respectively, demonstrating the level of control allowing application in general industries.



This project was carried out with a subsidy from KEIRIN.

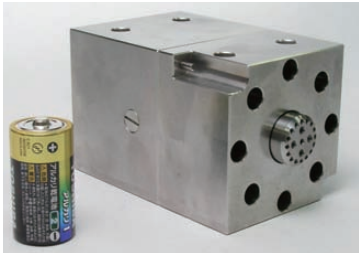
Development of ultra-precision machine tool using ADS high-precision drive

Application and required performance of ultra-precision machine tool

(1) What to make?: High-accuracy products, such as metal molds for various lenses and silicon wafers
(2) What level of accuracy required?: Processing accuracy of a few nm to tens of nm
(3) What are needed?: Processing devices with high accuracy of motion, high rigidity and high thermal stability.

Advantages of ADS

(1) Low viscosity, (2) High thermal conductivity (to the air or oil),
(3) Cleanness (semiconductor manufacturing equipment)



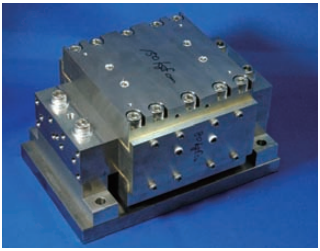
Water drive spindle

- **Water drive spindle**

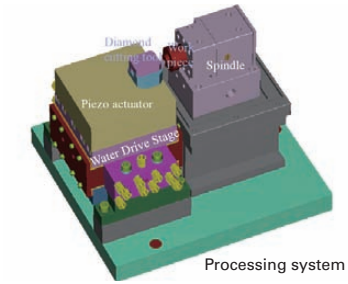
The water drive spindle rotates at the high-speed, high-accuracy rate of 10,000 rpm, by forming a water flow channel inside the rotation shaft supported by a hydrostatic pressure bearing and running the water through the channel at around 20L/min. Further, as the water flowing inside the rotation shaft is temperature-controlled, a high level of thermal stability is obtained.

- **Water drive linear motion table**

A high-accuracy linear motion table is an indispensable prerequisite for the ultra-precision machine tool. A water drive linear motion table drives a table, which is in a floating state with the hydrostatic pressure bearing, with the hydraulic drive in a non-contact manner. In particular, since the driving force is applied on the table's center of gravity, a high degree of motional accuracy is obtained.



Water drive linear motion table



Processing system

- **Minuature water drive ultra-precision processing system**

A minuature-sized ultra-precision processing system has been developed, combining a water drive spindle and a water drive linear motion table. This processing device can be used for creating a mirror surface made by a cutting work.

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■ **JFPA-URL**
http://www.jfpa.biz

■ **The world of ADS (JP)**
http://www.jfpa.biz/wp-content/uploads/jfpa_whwg2.pdf

■ **Weblog on hydraulics (JP)**
http://aquadrive1999.blog129.fc2.com/

■ **Technical writing/translation**
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