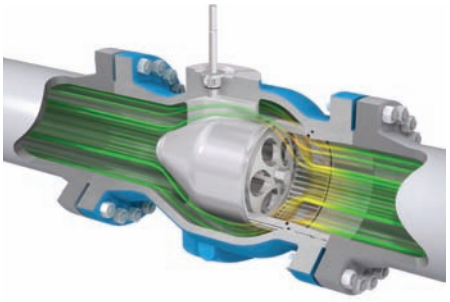
# Axial excellence in China's gas transmission network

**China is a fast developing market, requiring the latest in technology with very demanding standards for operations and reliability. This is especially true in the energy sector. Mokveld Valves BV from the Netherlands has successfully introduced axial valve technology for large gas transmission projects in China. In this article, Mokveld presents some benefits of the use of axial control valves and provides some specific project application examples of their engineered valve solutions in China.**

*By Chris Charles and Machiel Bosma*



Since the early 1900's an exceptional valve concept was used in hydro power plants: the axial flow valve. Axial flow refers to the streamlined symmetrical and unrestricted flow path between the valve inner and outer body. In the 1950's Mokveld acknowledged the advantages and adopted the concept into their control valves designs. Over the last decades, this axial control valve has captured a strong position across the full range of gas and oil segments; production, processing, transmission, storage and distribution.

## A mature solution

By nature of design the axial control valve has unique benefits that make the valve specifically suitable for the more special and severe service control applications. Mokveld's engineering specialists added innovative trim technology, fully pressure balanced piston and most vital: the Total Velocity Management® concept. The axial control valve solutions offered today are the evolution of all the valves that have been developed over the past fifty years. Axial flow has evolved from a unique concept to a mature design.

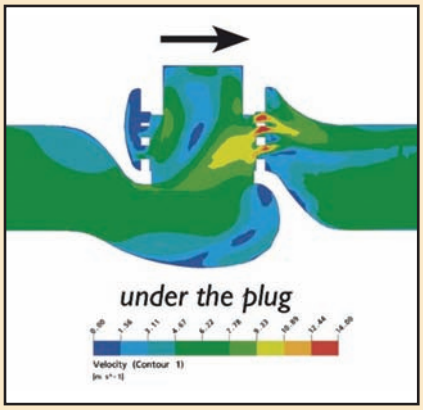
## Total Velocity Management® concept in the field

Control valve selection is often based on outdated design philosophies and capital expenditure. However, control valves are critical elements in a process loop. Malfunction or failure of a control valve can seriously affect safe plant operation and the environment. Valve selection should be based on sound technical and economic arguments and long-term perspectives. Selecting a valve with proven reliable performance will help to reduce costly maintenance and lost production time.

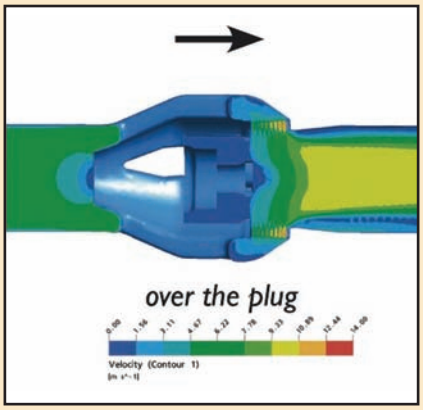
Conventional globe style control valves are still used extensively. However, the "S" shaped body results in preferential flow with localized high fluid velocities being the prime source of noise, erosion, vibration and malfunction resulting from unbalanced forces. Prevention is better than cure. Mokveld Total Velocity Management® concept is an intelligent axial valve design that carefully manages fluid velocity in all areas of the valve (trim and body). Source treatment by Total Velocity Management® is the key to reliability and safety.

## Axially shaped for demanding applications

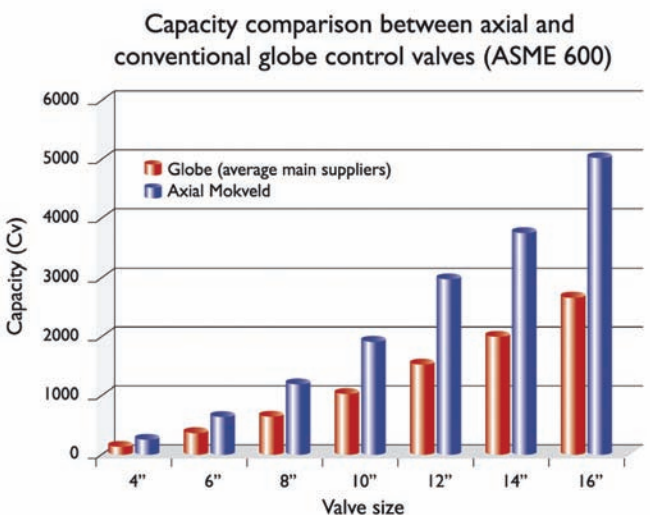
In the axial flow design the streamlined annular flow path - and the evenly distributed flow through the cage - reduce high local velocities, turbulence and impacts of flow jets and particles. This is fundamental for reliable valve performance because vibration, erosion and unbalanced flow and forces are avoided. With a minimum of turbulence and change of the fluid velocity, there is no energy conversion in the valve body itself. Pressure drop is taken over the trim only,




**Conventional Globe Valve**
Preferential flow deteriorates trim performance and leads to unbalanced trim forces.




**Axial Control Valve**
Axial flow and source treatment by Total Velocity Management® is key to reliability




## Silently setting the tone for special control

A control valve in operation is an integrated unit with several different sources of noise:

1. Noise generated by energy conversion over the trim
2. Noise generated by turbulence or cavitating flow throughout the valve body
3. Mechanical noise generated by vibrations and resonance of components

Total Velocity Management® concept combats noise sources in all the above areas. The axial control valve body is of a high-pressure recovery design (low Fl value) which means that the energy conversion exists within the trim only. This as opposed to the conventional globe valve, where a portion of energy conversion is uncontrolled within the valve body itself. As a result of the evenly distributed flow through the axial cage - full surround flow - the trim noise abatement technology is used efficiently. Both the flow induced noise and the mechanical noise are minimised as a result of the streamlined flow path.

which has been specifically designed for this task. As a result unplanned process downtime is avoided and maintenance cost (total cost of ownership) are reduced.

### High capacity

The inherent capacity of the axial control valve is very high compared to conventional globe control valve designs and enables the selection of a smaller valve size. Alternatively the higher capacity can be used to minimise pressure drop over the valve or to provide for special features, such as a modified control characteristic, additional noise abatement, anti-cavitation or a wider operating envelope for future process changes.

### Accurate and quick control with small actuators

As a result of the evenly distributed flow through the cage, the dynamic forces on piston operation are negligible. The Mokveld axial control valves are fitted with a fully pressure balanced piston assembly which makes the operating thrust virtually independent of the differential pressure across the valve.
Fast response and short stroking times, as typically required for compressor surge control, are achieved with relatively small and maintenance free spring return actuators. The Mokveld axial control valve can control stable and accurately between 2 - 100% of the valve stroke which makes the valve suitable for applications that require high turndown (650: 1).

### China's Gas Transmission Network

For 2009 the valve demand in China equals 3,8 billion dollars, while the valve production has a value of 5,2 billion dollars. The key to the Chinese interest in Western valve technology lies in the fact that the Chinese have very demanding standards for operations and reliability, requiring state-of-the-art technology. Furthermore expertise and valve systems engineered specifically for the application are highly appreciated.
The majority of China's gas transmission pipelines are designed (and often constructed) by China Petroleum Pipeline Engineering Corporation (CPPE). CPPE has been responsible for over 30,000 km of various medium, large diameter and long-distance pipelines accounting for nearly eighty percent of the pipeline market in China. During the 1990's Mokveld introduced the axial flow concept to CPPE.

***In the following projects axial valve technology was used for critical control applications and High Integrity Pressure Protection Systems (HIPPS):***

### The West-East Gas Pipeline Project (WEGPP)

Petrochina's WEGPP is an extraordinary large project, initiating from Xinjiang and ending at Shanghai. It is nearly 4.000 km in length, 1.016 mm in diameter with a design pressure of 10 Mpa (valves rated to ASME class 600). The designed annual gas throughput is 12 billion cubic meters. The total investment reaches 45 billion Renminbi (approx. 4,5 billion Euro). With the largest diameter, longest length and equipped with the most advanced technology this is the benchmark for other gas transmission projects in China.


Following initial operation it was found that the compressor stations had capacity and control issues with the globe-style anti-surge valves supplied by some of the compressor vendors. CPPE turned to Mokveld and replaced the existing globe control valves with axial control valves. The capacity issues were solved, stability of control was improved and in addition the produced noise decreased. The current compressor stations have 16" ASME class 600 valves installed. To date axial control valves are used in all area's requiring accurate and reliable control, such as metering skids, compressor anti-surge, re-cycle services and gas storage. More than 250 Mokveld valves are in service on the WEGPP

**The 2nd West-East Gas Pipeline Project**

Mokveld are now working with CPPE on the conceptual and design engineering of the 2nd WEGPP. A new challenge - from a pipeline perspective - is the design pressure of 12 Mpa (ASME rating class 900). For Mokveld class 900 valves up to 48" (DN 1.200) are standard. In the control valve area this means many pressure reducing stations at each of the tie-in's to the existing ASME class 600 rated network and also new branch lines. In these stations reliability and stable control accuracy are paramount to ensure that the operations are continuous and costly downtime is avoided. This project will use axial valve sizes and ratings not yet found in China's growing gas transmission network.

## Various Projects with comparable Axial Valve Systems

**Beijing Huayou Gas Company Ltd (BHGC) use Mokveld engineered valve systems extensively in the following operations:**

- Shaan Jing gas pipeline, which runs approximately 1.100 km from Jingbian in western China to Beijing and Tianjin in the east.
- The second Shaan Jing gas pipeline. Here axial control valves and HIPPS can be found in the Jingbian initial station, Beijing Terminal station and various metering stations in sizes up to 20 inch ASME class 600.

**Other pipelines utilising axial control valves include:**

- Zhejiang Province Gas Pipeline Companies Hangzhou-Ningbo Gas Pipeline,
- PetroChina's Se-Ning-Lan, Sichuan, Zhongxian-Wuhan and KC-13 Gas Pipelines
- CNOOC's Dongfang-Yang Pu Gas Pipeline

The China Petroleum and Chemical Corporation's (Sinopec) Sichuan to East gas pipeline covers a distance of 1.700 km and is designed to handle a flow of 12 billion cubic metres annually. This is one of the companies latest success's. This project has also utilised axial control valves in sizes up to 20 inch ASME class 600 sizes. In total, more than 500 axial valves are installed in China's burgeoning gas transmission network.