Water meters and factors influencing performance

By

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ABSTRACT:

The importance of accuracy and reliability of watermeters cannot be over-emphasised especially in the supply of water to big cities with complex water distribution network. The water meters are measurement equipment and hence their performance is critical in their selection.

This paper focuses on flowmeters, their classification and factors influencing performance. The watermeters ranges from small household meters to large supply meters.

CLASSIFICATION OF FLOWMETERS

Metering meters of fluid can be classified as follows:

- Flowmeters
  - Flow rate meters
  - Quantity meters
    - Turbine meters
    - Positive Displacement meters
    - Inferential metres
      - Orifice Plate
      - Venturi tube
      - Nozzle
    - Rotameter
    - OTHER TYPES
      - Magnetic induction
      - Mass meter
      - Ultrasonic
      - Laser Anemometer
      - Fluid Oscillatory meter
      - Nuclear magnetic resonance
QUANTITY METERS

These include volume proffers volume weighing scales among others.

FLOWRATE METERS

A. **Turbine meters**
   - Rotary Turbine meter
   - Propeller meter
   - Axial Turbine meter
   - Twin rotor

B. **POSITIVE DISPLACEMENT METERS**
   - Oval gear
   - Reciprocating

C. **INFERENTIAL METERS**
   - Orifice plate
   - Ventun tube
   - Nozzle
   - Rotameter
   - Pitot tube

D. **OTHER TYPES OF METERS**
   - Magnetic Induction - Using laws of Faraday of magnetic induction
   - Mass flow meters e.g. i) coriols meter  
     ii) gyroscopic meter
   - Thermal meters - e.g. hot wire, heat loss type
   - Ultrasonic - using sound interference principles
   - Laser Anemometer - using light interference principle
Different meters perform and exhibit different characteristics when subjected to the same flow conditions and this calls for a careful analysis in selecting a meter for a particular task. This information is given by a manufacture and is available with those institutions which are entrusted with evaluation of performance of meters.

HOUSEHOLD WATER METERS

The household meters consist of three parts which are :-

1. The meter body (outside/inner or both)
2. The metering part
3. The readout part.

The body of household meters is made of a metal while the metering and the readout scale are made of polymer material (see figures 1. a&b).

Fig.1(a) 

fig.1(b)

The metering part is essentially impellers designed to be driven by either a disturbance due to flowing water or air and coupled to a train of gears which are attached to a reading scale(s).
The readout scale can be attached to a pulse generator connected to pulse counter and hence volume passed is read at an electronic device.

TESTS ON HOUSEHOLD WATER METERS

Normally, there are two types of tests carried on water meters as follows:

1. Normal calibration
2. Type/Pattern Approval

TYPE/PATTERN APPROVAL

This is carried out on new type of design of a household water meter. The tests are specified in OIML Recommendation No.49 and found in many national standard specifications. The type of tests may vary from one country to another but the common tests are:

1. Life cycle test - To verify performance after many hours of running (1 week - 2 weeks non-stop).
2. Pressure test - To verify water shippage at high pressures as per specifications.
3. High temperature test - To verify performance at higher operational temperatures.

These tests are costly to perform and are limited to few meter samples as possible.

CALIBRATION OF WATER METERS

Calibration of water meters is carried out as specified in National Standards or ISO Standard i.e. ISO 4064/1&2 and the error limits are given as:

\[ a) \quad \pm 2\% \text{ at } Q_t \text{ - } Q_{\text{max}} \]
\[ b) \quad \pm 5\% \text{ at } Q_{\text{min}} \text{ - } Q_t \]

The errors in calibration of water meters are calculated from the formula:

\[ \text{Error \%} = \frac{V_m - V_s \times 100}{V_s} \]
Where $V_m$ - Volume of the meter under test

$V_s$ - Volume of the gauging standard

Below, typical schematic diagram of a calibration line and a meter error curve are respectively given.

Fig 2- Schematic diagram of a meter calibration line

![Schematic diagram of a meter calibration line](image1)

Fig 3- Typical error curve of a water meter

![Typical error curve of a water meter](image2)
Factors Affecting Performance of Water Meters.

The factors affecting performance of water meters commonly the same for either small household water meter or big water consumer meters. But, the small meters are more sensitive to quality of water metered because they tend to clog the inner housing of the water meter and cause big errors in reading and sometimes, they can even make the water meter stop indicating.

Other factors, which influence performance of water meters, are:

1. **Fluid Properties**

   These properties are temperature, operating pressure, specific gravity, viscosity and sometimes compressibility due to gases in the water. The temperature range is quite wide (maximum 50°C) but the pressure influence in metering is quite critical for it can cause pipe bursts or damage the water meter.

2. **Pressure drop at maximum flowrate**

   Extreme pressure drops leads to cavitation and consequently fault in metering by causing the fluid to break.

3. **Installation**

   Some meters are sensitive to disturbances e.g. turbine meters. The installation requirements for meters as specified in the standards should be observed and the necessary valves, bends etc should be located at right distances from the meter. The meter should be installed at places with no influence of electromagnetic and vibration interferences.

4. **Meter Accuracy**

   Accuracy levels are very critical especially in bulk metering or custody transfers e.g. the big consumers. A bulk meter should be selected with in mind of the expected accuracy level besides its operational principle and rangeability.
CONCLUSION

Although water is an essential commodity, its supply is an economical venture and its accurate metering is very critical in ensuring fair trade. This calls for reliable designed metering system and the meters have to be calibrated at agreed intervals depending on the nature of the metering operation. Selection of a particular meter then becomes of paramount importance, which needs no emphasis.
Biography

Joel Kioko is a chief principal officer in the Metrology Division of the Kenya Bureau of Standards. He is the head of Mechanical Branch Laboratories which consists of volume/flow, pressure, temperature, density/viscosity, force, mass and dimensional measurements. He is a holder of bachelor and masters degrees in Physics and Measurements techniques from Nairobi and Oldenburg (Germany) universities. He is a holder of post-graduate diploma in Metrology specializing in volume and flow measurements. He has attended volume/flow measurements attachments in PTB (Germany) and FCRI(fluid control and research institute-India).

He has experience of more than 20 years since 1978 in the field of Metrology (Science of Measurements) and has risen from being the head of volume/flow laboratory, head of thermodynamics department to head of mechanical branch of the Kenya Bureau of Standards Metrology Division.
The Kenya Bureau of Standards (KEBS) is the National Standards Body (NSB) of Kenya. It was established by an Act of Parliament - THE STANDARDS ACT, Chapter 496 of the Laws of Kenya. It started its operations in July 1974.

The Bureau’s Board of Directors is known as the National Standards Council, which is the policy-making body for supervising and controlling the administration and financial management of the Bureau. The Managing Director, who is the Chief Executive, is responsible for the day-to-day administration of KEBS, within the broad guidelines formulated by the Council.

The aims and objectives for KEBS include development of standards, testing of products and services, calibration of measurement instruments, consumer protection, quality management, training for industry and dissemination of information relating to standardization.

To promote and realize standardization activities countrywide, KEBS has established Regional Offices in Mombasa and Kisumu towns.