The Benefits of Non Mechanical Water Metering Technology to the Water Industry

Presentation by

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The Benefits of Non Mechanical Water Metering Technology to the Water Industry

Introduction

The permanent measurement of potable water flow and consumption in water utility systems, for water management and billing purposes, has been dominated by mechanical metering technology for over 100 years. Non mechanical, potable water, metering technology is emerging that is already revolutionizing accurate water management, substantially decreasing metering costs and increasing captured revenue.

What benefits do these new technologies provide?
To fully understand the benefits of non mechanical water metering we must first have to understand some basic facts in relation to mechanical metering.

Therefore this Presentation will Address

- The goal of modern metering
- A VERY brief history of mechanical water metering
- Mechanical meters and their development over time
- The definition of a Non Mechanical water meter and some examples
- The advantages of Non Mechanical over Mechanical meters
- Final Comments
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The goal of modern metering

To record and to retrieve, potable water usage data, as accurately as possible and as efficiently as possible, for minimum cost, compared to the value of the data collected.

The “Value” of the data is measured as:-

Billing Revenue Value – The $ value of the water consumed by the customer and associated sewerage charges, they key being the more accurately you measure, on a consistent basis, the more you maximize your true revenue potential.
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The goal of modern metering

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\textbf{The “Value” of the data is measured as:-}

\textbf{Service Quality Value} – The added value that modern metering data presents, which in real terms reduces modern operational costs and provides a higher Quality Service to the customer.

- Management of water resources and water loss
- System and infrastructure management and development
- Environmental control and water efficiency
- Elevated customer services

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A Brief History of Mechanical Water Metering

The first documented references for a mechanical water meter were in 1790, detailing an “Inferential” turbine type meter invented by Reinhard Woltman. As a testament to his ingenuity, the “Woltman” type mechanical water meter is still used to this day, and is officially referred to as a Class II Turbine meter.

Woltman Concept of 1790

Modern “Woltman” Class II Turbine

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- A Brief History of Mechanical Water Metering

The first reference to a “Positive Displacement” (PD) type meter was in fact the modification of a water pump. Each stroke of a piston equaled a known measurable volume of water. The first commercially available PD, “Piston” type water meter was patented in 1885. The Nutating Disk type water meter first appeared in 1887.

Piston Type Meter of 1885

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Mechanical Meters and Their Development Over Time

Typically it has not been the general concept of the measurement method that has changed; it is the changes in modern materials and manufacturing mechanical tolerances that have ultimately improved somewhat the longevity and robustness of the mechanical meter measuring element.

The mechanical measuring process has not significantly changed in over 100 years, but modern designs, materials, manufacturing processes and tolerances have.

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Mechanical Meters and Their Development Over Time

What has seen the major changes in modern technology advances is the meter REGISTER, with Automatic Meter Reading (AMR), and more recently AMI, Automated Metering Infrastructure systems. Basically all the advances to date simply enable the meter register to be read from a distance (Walk by / Drive By meter reading) or, more frequently, from a central point (Fixed Network meter reading systems).
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- Mechanical Meters and Their Development Over Time

Modern AMR and AMI systems are only a means to collect data effectively and have no bearing on the collected data accuracy. The point being:-

If you do not MEASURE accurately, you can not MANAGE or BILL accurately!
The Definition of a Non Mechanical Water Meter and Examples.

The definition of a non mechanical (or Solid State) water meter is generally accepted as:-

A permanently installed water meter, designed for measuring and displaying potable water flow and consumption (and the preferred ability to provide AMR / AMI outputs), where the only moving component is the water being measured.

Examples are……………….
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- The Definition of a Non Mechanical Water Meter and Examples.

**Electromagnetic Type Water Meter** - although available in sizes from 15mm and upwards, these meters are currently aimed at Industrial, Commercial or Institutional applications, typically 2” or larger in size.
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The Definition of a Non Mechanical Water Meter and Examples.

Do not confuse Electromagnetic WATER Meters with Electromagnetic FLOW Meters, they are uniquely different and are designed for very different applications. Electromagnetic Flow meters (Mag Meters) have been around for over 40 years, but the technology is only suitable for process and industrial applications; however within the last 15 years, specifically designed Electromagnetic Water Meters have been introduced to the water industry that have surpassed the range of flow accuracies required in Potable Water Service Metering.
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- The Definition of a Non Mechanical Water Meter and Examples.

**How does an Electromagnetic Water Meter Work?**

Non magnetic tube

**Faraday’s Law**

Faraday’s Law of Electromagnetic Induction states that the Voltage induced by a conductor moving through a magnetic field, will be proportional to the velocity of the conductor.
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The Definition of a Non Mechanical Water Meter and Examples.

**Fluidic Oscillator Type Water Meter** – current versions of this type of technology are aimed at the Residential water metering market.

It was in the 1960’s when fluidic Oscillator devices were used in industry for both gas and liquid measurement, it is only within the last 15 years that fluidic oscillator meters have been commercially feasible for residential water use measurement.

A Limited Battery Life and high cost, currently makes Fluidic Oscillators unpractical for a Residential Mass Market, however as this technology evolves, longer life expectancy will make these meters economically viable in the future.

Modern Fluidic Oscillators

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How does a Fluidic Oscillator Water Meter Work?

A special design of water flow chamber creates a fluctuating pressure sequence that causes the water flow to oscillate.

The frequency of the oscillations is directly proportional to the velocity (speed) of the water.

Sensors in the flow chamber count the oscillations.
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The Advantages of Non Mechanical over Mechanical Metering.

A SINGLE disadvantage of the Mechanical Water Meter has a SUBSTANTIAL and COMPOUNDING effect on its accuracy and operational cost.

MECHANICAL FRICTION
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- The Advantages of Non Mechanical over Mechanical Metering.

**MECHANICAL FRICTION**

- Continuous Component Wear
- Increasing Loss of Accuracy over time
- Increasing Loss of Revenue
- And
- Poor Management Data
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- The Advantages of Non Mechanical over Mechanical Metering.

Accuracy %

Lost Revenue & Poor Management Data

Literally Money Down the Drain!

Time in Years
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Managing Residential Mechanical Meter Wear

Typically residential water meters are replaced when they reach anywhere between 15 years to 25 years old.

Loss of accuracy, and therefore loss of revenue, is compounded by the sheer number of old residential meters in use.

The only viable solution to reduce loss of revenue is to replace residential meters more frequently.

Unfortunately the modern costs associated with replacing a Residential water meter, more frequently, do not make this an economical solution, so realistically the true revenue potential from billing is never achieved.
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- The Advantages of Non Mechanical over Mechanical Metering.

Managing Bulk and Commercial Mechanical Meter Wear

Bulk and I.C.I. meters typically wear quicker depending on usage, but simply replacing these large and expensive meters is not cost efficient, and therefore they undergo periodic testing and maintenance to keep them accurate. This equates to high operational costs.

Operational Costs

- Testing Costs
- Repair Costs
- Replacement Parts Cost
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The Advantages of Non Mechanical over Mechanical Metering.

**Bulk Meter Accuracy Example**

Large New England Utility.

15 randomly chosen ICI mechanical meters, ranging from 3” to 8” in size, removed and tested after 10 years service.

<table>
<thead>
<tr>
<th>Meter Size</th>
<th>Overall Meter Accuracy</th>
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<tbody>
<tr>
<td>3”</td>
<td>97.20%</td>
</tr>
<tr>
<td>3”</td>
<td>93.00%</td>
</tr>
<tr>
<td>4”</td>
<td>91.70%</td>
</tr>
<tr>
<td>4”</td>
<td>45.70%</td>
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<td>15.90%</td>
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<tr>
<td>6”</td>
<td>92.60%</td>
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<tr>
<td>6”</td>
<td>90.40%</td>
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<tr>
<td>6”</td>
<td>27.70%</td>
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<td>24.30%</td>
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<tr>
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<td>57.50%</td>
</tr>
<tr>
<td>6”</td>
<td>0%</td>
</tr>
<tr>
<td>8”</td>
<td>89.40%</td>
</tr>
</tbody>
</table>

**Average Accuracy 55.35%**

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The Advantages of Non Mechanical over Mechanical Metering.

Solid State, Non Mechanical Meters DO NOT suffer from Mechanical Friction and Wear.

DO NOT Lose Accuracy
Maximizing Revenue Potential
and Management Data

DO NOT Require Maintenance or Spare Parts
Substantially Lowering Operational Costs
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The Advantages of Non Mechanical over Mechanical Metering.

**In addition:**

Non Mechanical Meters do not require filters or strainers.

Electromagnetic water meter Sensors can be buried, eliminating expensive chamber costs.

By eliminating routine maintenance or removal from service, there is no need to install a meter by pass, further reducing installation costs.

Fire Service Approved Electromagnetic water meters are very compact and are very much less expensive and much smaller than their Mechanical equivalent and again can be buried if required.
The Advantages of Non Mechanical over Mechanical Metering.

There is another important point to be understood in direct relation to Mechanical Compound Meters, where a Non Mechanical meter has a significant advantage, resulting in further more accurate water measurement.

Mechanical Compound water meters are designed to measure a wide range of flow, which can not be achieved by a single meter type. A Compound meter is actually two meters in one, a small measuring element, which usually measures the low flows, and a large measuring element that measures the high flows.
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- The Advantages of Non Mechanical over Mechanical Metering.

As the flow rate increases or decreases a “mechanism” within the meter diverts the flow either through the small or large measuring element. The period during the diversion of flow is referred to as “Crossover” and it is normal for Mechanical Compound Meter manufacturers to publish a loss of accuracy during the crossover range.

The key point is that while in the crossover range, the meter accuracy reduces. When compound meters are tested it is normal for the test flows to be a continuous linear increase or decrease so the “loss of accuracy at Crossover” will normally be published at between 3% and 5%.

However in normal water service conditions it is unusual to find continuous linear crossover flow conditions, and in real terms, loss of accuracy at crossover can be anywhere from 5% to 20% or even more. Furthermore it is typical to find that the smaller measuring element experiences higher than normal mechanical wear and will likely experience a quicker than normal loss of accuracy at the low flow rates.
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The Advantages of Non Mechanical over Mechanical Metering.
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The Advantages of Non Mechanical over Mechanical Metering.

Loss of accuracy at Crossover can be minimized by investigating (datalogging) the flow profile on a service, before deciding what size of compound meter to install (or if to install another type of meter altogether).

Compound meters also require the most operational maintenance to ensure they are working as accurately as expected.

A Non Mechanical Electromagnetic Water Meter will measure more accurately the full range of flow on services where typically a Mechanical Compound meter would be installed. The added advantage is that the Electromagnetic Water Meter does not experience crossover and remains accurate through the full range of flow, without any operational maintenance required.
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4” Compound Typical Accuracy Curve compared to 4” Electromagnetic Water Meter
Final Comments

Many of these new Non Mechanical Water Metering technologies are already recognized and approved by international standards, but what about North America and especially Measurement Canada.

The AWWA already recognizes this new technology.

In 1999 a draft Standard was written for Electromagnetic Type Water Meters, but was never fully approved.

A quote taken directly from this document states:

“Magmeters will continue to gain popularity in the water industry. The performance and the reliability of these meters with no moving parts require less maintenance and are more accurate than mechanical meters in use today”
Final Comments

Currently, the AWWA is in the process of finalizing an AWWA Standard for Electromagnetic Water Meters.
Final Comments

It is understood that Measurement Canada, will acknowledge and incorporate Non Mechanical Water Metering Technologies, into the final published Measurement Canada Standards, that are to be introduced sometime in the future.

The International Standard OIML R-49, that is likely to be one of the required Standards adopted by Measurement Canada, already incorporates Standards for Non Mechanical Water Meters.
Final Comments

The final conclusion is that there is no doubt, the metering of potable water services using, solid state, non mechanical water metering technology will eventually replace mechanical meters, the real question is how long will it take for this transition to take place.

The answer to this question, is really in the hands of the water industry itself, in how quickly the advantages are fully recognized and the new technologies adopted.
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Final Comments

Thank You................

Any Questions ?