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Practitioners in the field have been asked about their experiences with regard to:

- i) Measuring flow of air, steam and water with online and mobile intrusive or non-intrusive equipment.
- ii) Measuring % O₂, % CO₂ or % CO in the stack gas of construction systems.

Considering our very good experience of using a few innovative flow measuring instruments prior to 1986 of special type like **electro-magnetic flowmeters, vortex flowmeters in chloromethane plant with Japanese Technology..**,

From 1990 onwards, we **adopted** the following selection criteria for application of online flow measurement of **air, water, steam** instead of conventional orifice-meters which produces differential pressure drops.

Details of application of vortex flow meters and electromagnetic flowmeters is tabulated as under at Gujarat Alkalies and Chemicals Limited complexes at Vadodara & Dahej in Gujarat.

Sr.No.	Service or Application	Type of instrument	Make	Quantity Installed
01	Air:	Vortex flowmeter	FOXBORO, YOKOGAWA, E+H	05
02	Steam:	Vortex flowmeter:	YOKOGAWA, E+H	118
03	DeMineralized Water(DMW)	Vortex flowmeters	YOKOGAWA	03
04	Chlorine Gas:	Vortex flowmeters	FOXBORO KROHNE	02
05	Natural Gas:	Vortex Flow meter	YOKOGAWA	02
06	Naphtha Liquid:	Vortex Flow meter	E+H	03
07	Liquid Effluent:	Electro-Magnetic Flow meter	KROHNE	02
08	Raw/Process Water:	Electro-Magnetic Flowmeter:	E+H	05
09	Brine (NaCl)	Electro- Magnetic Flowmeter	KROHNE-MARSHAL	48
10	Inorganic fluid: (Phosphoric-Acid Plant)	Electro –Magnetic Flowmeter:	KROHNE-MARSHAL	40
11	Organic fluid:	Electro-Magnetic flowmeter	KROHNE-MARSHAL	10
12	Low-Pressure, High Volume Air:	Annu bar sensor with: Different pressure Transmitter.	Rosemount	01

Comments on experience of Vortex flowmeters;

Our experience of using Vortex flow meters as above is very good in **following aspects**.

Experience on Vortex flowmeters:

1.	Accuracy:	It gives 0.5-1.0% accuracy (better than @ 2% of overall accuracy of orifice meters-loop)
2.	Handling:	Its simple construction without any mechanical complexity like turbine-flowmeter or positive displacement meter, it is easy to handle and rugged in construction with no moving parts .
3.	Reliability:	Vortex flow meters are highly reliable as per our experience of using large nos on steam application since 1986. (only one has failed due to electronic component failure so far) Completely maintenance free & hence reliability is proven.
4.	Suitability:	We have found vortex flow meters suitable for all the six applications of air, steam, water, naphtha, Chlorine gas and Natural gas applications.

Comments on Electro-Magnetic Flowmeters:

We have ADOPTED philosophy to use electro-magnetic flow meters **wherever the process-liquid has conductivity more than 5 micro-siemens / micro-mhos**.

We have installed-----electromagnetic flow meters on various services inclusive of raw water supply line of 14" dia size **as tabulated above** and our experience for the same is excellent with specific details as under:

Experience on Electromagnetic flowmeters:

1.	Accuracy:	1% to 2 % : very good
2.	Handling:	Easy to install (like a spool piece in a pipe-line)
3.	Reliability:	Not a single failure in above flow meters installed since 1993 onwards. Completely maintenance free.
4.	Suitability:	This is the most suitable flow measuring device will no additional pressure-drop for all conductive liquids with even as low conductivity as 5 micro-siemens / mhos .
	Calibration: For both : Vortex & Magnetic Flowmeters	Both, Vortex and Electromagnetic flow meters are calibrated by renowned suppliers like Yokogawa, Endruss & Hauser (E+H), Rosemount, on ACCREDITED rigs according to <u>internationally, recognized standards to meet ISO 9000 compliance</u> . No mechanical calibration is required or calculations required like orifice meters.

Added Advantages:

- With ingress of micro-processors in above instruments, it is possible to get in-built Integrator for flow-totalizing and pulse / digital as well as analog output for

remote control or monitoring on DCS (Distributed Control System) in graphical form.

- Such meters can also be connected to a Personnel Computer using interface of specially designed hardware and software to serial interface connection of RS232C.
- Vortex meters ranges DN 15 to DN 300 (1/2" to 12") in size with flow range of **(3-25 m³/hr) to (1600-19000 m³/hr) for air** AND **(0.15 to 5 m³ / hr) to (55-2300 m³/hr) for water/liquid**
- Vortex flow meters have much better **rangeability of 40:1** as compared to **3:1 of orifice plate meters** making it versatile in use with low inventory requirements as per our experience.
- Operating Process temperature up to 200⁰ C is possible in both types with ambient operative range up to 60⁰ C.
- Water velocity up to 7.7 m/s and Gas velocities up to 183 m/s can be accommodated for fuel, air, steam, and gas in the standard design.

We have installed a large base of vortex flow meters (50 mm to 200 mm dia) and electro magnetic flowmeters of sizes ranging from 4 mm dia to 400 mm dia. on various applications as tabulated above.

Our Phosphoric Acid Plant has **no orifice meters** due to extensive use of electromagnetic flow meters and vortex flow meters.

We shall be happy to reply any specific query / details for above submission (inclusive of detailed specifications) to share our experiences as **low initial cost, low installation cost, low maintenance cost, low operation cost with high durability,**

Thus,we have found the **cost of ownership very low** in our experience of more than a decade for both these types.

We have **no experience of using non-intrusive, mobile instruments** and hence do not comment on the manufacturer's claim for accuracy and reliability.

CO₂, O₂, CO measurements in stack gases:

We do not have any on line measurement of CO₂, O₂, or CO% in stack –gas. We take the stack-gas sample and get it analyzed in our Quality Control Department for the stack gas at GACL.

Some of zirconium based portable O₂ analyzer is there and our experience for the same is satisfactory.

We are looking forward to get useful information on these based on field/practice by industry in response to this query # EE-21by other experts who have installed large base of such stack gas analyzers.