McCROMETER

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Test Separator / Off-Shore Metering

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2.0 Philosophy for Test Separator Meters by V-Cone Meters:

(As agreed M.M.S. US offshore waters 1999 for non-API Paper Standard Design)

2.01 Pre – Amble:

Current design of multiphase separators allow overall uncertainty (on all three phases) of about 15% - 20% according to recent API discussions, this can be due to operator control, time delay in stabilization of the vessel, incorrect design involving future fluid levels, position of vessel in respect to the pressure head requirement (on liquid side) and also the main metering.

In particular where orifice meters are used it is necessary to perform, plate changes to facilitate turndown otherwise the performance of the system could be compromised, and to use upstream flow conditioners or velocity profile devices which add cost to a system. (Gas Outlet).

Long-term vulnerability using orifice plates in production separators can be demonstrated by examining public documents in the measurement field.
(Examples cited in this document from Phillips Petroleum Embla)

2.02 Possible Problems Orifice Technology:

<u>Beta Edge Degradation, Stagnation Area, and Deposition.</u>

During the use of a velocity profile sensitive device (as an orifice) it is necessary to confirm that the beta edge of the device is both clean and has not been compromised due to trash & debris.

Current API paper standards address a clean dry and non-polluted gas, which does not take into account generally an offshore usage condition, this can result in high maintenance and intervention cost due to frequent plate changes.
Where paraffin’s or sulphate deposition occurs in the pipe in almost all cases shift in the Cd is caused in these types of device due to a re-circulatory effect at the rear of the device and also there is a stagnation area up-stream of the device where heavy end hydrocarbons can collect. (see enclosed Photo examples from Marathon Oil site)

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Wet Gas:

The current AGA/API paper standards, also do not address wet gas conditions, hence the use of an AGA/API standard to design a possible wet gas metering system can also end in higher intervention costs not generally assumed at the start up case.

Greater liquid injection over time to obtain more products on declining wells can result in an increase in wetness at the gas outlet. Examples of this can range from under-reading of the meter or over-reading depending on Reynolds No, Beta ratio, and liquid mass fraction seen at the meter.

Wet Gas Cont:

Research in this field by Chevron and others indicates a Cd movement of over 2% -3% outside of the predicted API requirements due to wet gas with liquid loads of 0.33bbl/MMscf as indicated in research.

Reference:

Dr V.C. Ting Chevron Corp: Effect of Liquid Entrainment on Orifice Meters.

Weight Penalty (platform design):

Current design of orifice require large up-downstream pipe lengths, this is good if you are a main contractor since not only can you supply the platform, but it is also possible to increase profitability due to the large weight related cost in installing large pipe runs, orifice carriers and supporting structures. Current weight penalty costs in the Gulf of Mexico can be from app. 12 $ per pound to 25$ per pound. Installing a system including all piping requirements and a cast carrier can amount to high dollar amounts in the platform support requirements . this can be compounded on deep water platforms.

Therefore using a device, which has low weight and reduced up-downstream piping needs, can reduce overall client installation costs outside of the pipe work alone.

2.03 V-Cone Technology Technical Attributes:

Real World Accuracy: Using calibration at a laboratory, it is possible to effect an accurate performance over 10-1 turndown better than that of a conventional differential producer.

Performance of +/- 0.5% at 10-1 turndown, with trash resistance, low beta edge degradation (edge is after the flow on V-Cone) and no stagnation area make the unit ideal for high cost intervention areas and long-term performance.

The low weight of the device will ensure economy of installation without having to purchase long piping lengths and high dollar flow conditioners (certain 12 inch flow profile generator units can cost over $8-10,000 dollars).

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The V-Cone can perform its on velocity profile conditioning as part of the meter design . The installation envelope can be reduced and direct coupling with elbows can be straight to the meter without performance degradation due to swirl or profile skewing.

Please note that the V-Cone weight is approximately only 1444 lbs for a 16inch #900 meter, 1161 lbs for 14 inch meter and only 945lbs for a 12 inch which is significantly lighter than both carriers and respective up-downstream. Piping for these size systems ,which can weigh more than 2.5 tons, per stream.

3.0.1 CEESI : Calibration Standards :

CEESI Air Rig :

NIST Primary Standard: traceable at 0.1% uncertainty

NIST Secondary Standard: traceable at 0.3-0.5% uncertainty

Pressures to : 2200 psi

Line sizes to: 120 inches

Other Gasses : N_2 He CO CO_2 AR CH_4 O_2 H_2

This test on AIR at correct Reynolds.

McCrometer Facility :

ISO 9002 accredited (1999) for V-Cone Production and Manufacturing System.

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Wet Gas Photographs:

Three months inspection for wet gas line (H2s + paraffin's)

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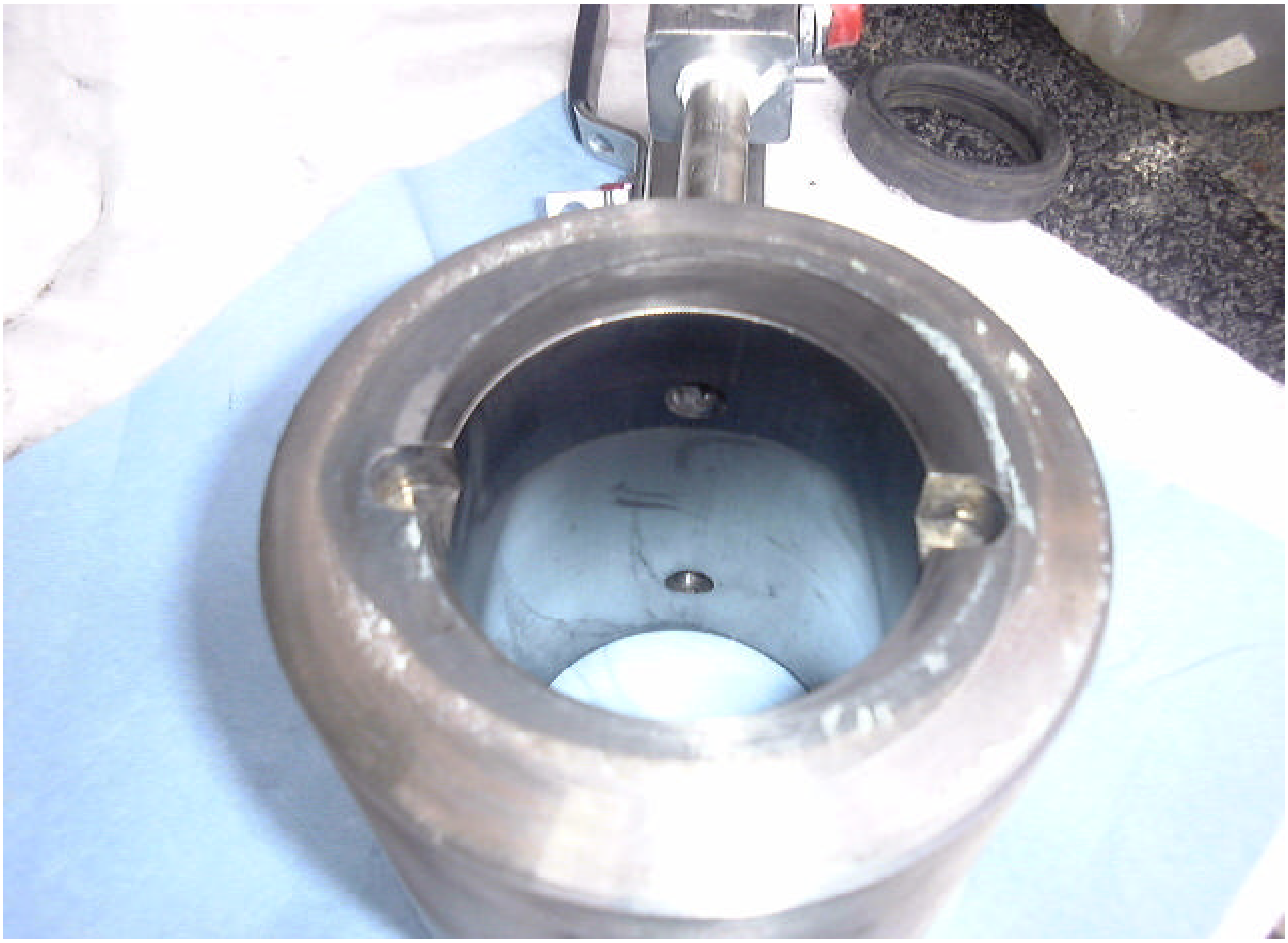
V- Cone after 9 months usage in same product lines



Note: Clean Body assembly

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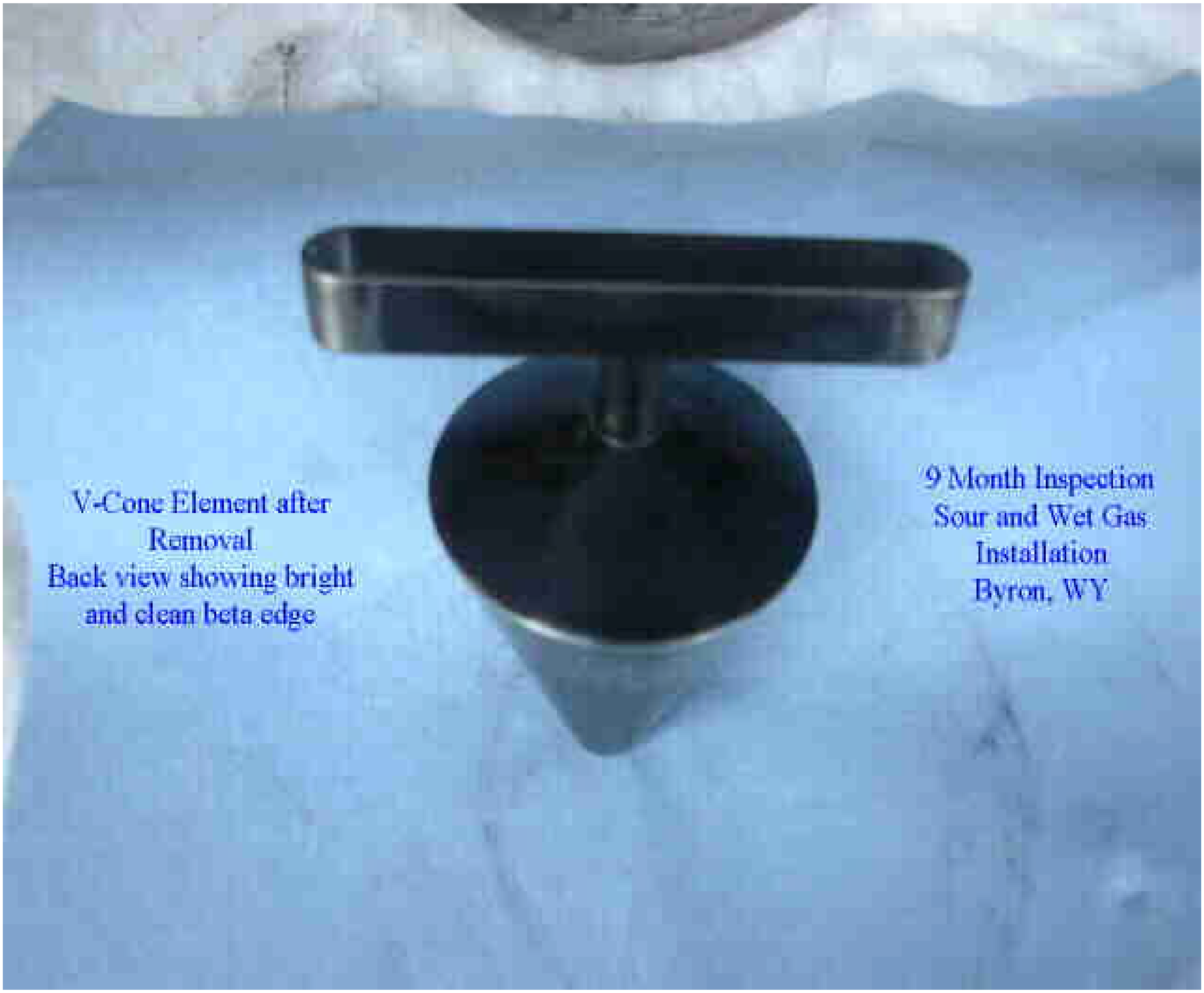
Cone removed (wafer design)



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