Common HydroSense Questions and General Information Guide

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-Operation Manual with Installation and Electrical drawings
-Brochure with technical specifications

1. Introduction to hydrocarbons and monitoring (6 pages)

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Introduction

Hydrocarbons are a common and natural occurrence in the environment and varying concentrations in stormwater and effluent water are not unusual. Hydrocarbons in water can be found as free floating, emulsified, dissolved, or adsorbed to suspended solids.

A hydrocarbon, by definition, is one of a group of chemical compounds composed only of hydrogen and carbon. Typically, hydrocarbons are broken down into three main classes; aliphatic, alicyclic, and aromatics. Further sub-classes can also be defined. Simply stated though, hydrocarbons are organic compounds made up of hydrogen and carbon.

Microbes in the soils and water have a natural ability to breakdown many of the these compounds and any hydrocarbon which is exposed to the air will also have an affinity to volatilize. As well, reactions including photochemistry, and the various transformations of the hydrocarbon through these reactions can enhance the hydrocarbon decomposition.

Industrial processes and man induced activities often result in the increased loading of hydrocarbons in water. The natural abilities of the water to decompose the hydrocarbons become overwhelmed and the resulting affect on the environment includes, but is not limited to:

-oils can affect respiration of fish by adhering to the gills

-oils adhere to and destroy algae and plankton

-feeding and reproduction of water life (plant, insect, and fish) is affected

-aesthetics is affected by sheens

-micro-organisms needed for plant nutrition is redirected to oil degradation

Typical sources of man induced hydrocarbons include the refining processes of crude oil into gasoline, lubricating oils , kerosenes, etc.. As well, the resulting commercial products find their way into the environment through stormwater run-off and spills from road asphalts, fueling depots (ie. airports, maintenance facilities), transportation and haulage, cooling water systems, manufacturing facilities such as automotive, plastics and steel production, and wood distillation industries.

Understanding hydrocarbons and the techniques to monitor for them is an important part in the assessment of filters and separators, and the associated productivity and environmental impacts they can have.

Hydrocarbons Defined

As stated simply above, a hydrocarbon is a compound of hydrogen and carbon. Of course, the chemistry involved can be a lot more complicated than this. In fact, there could be over 10,000 individual organic compounds in one sample of conventional or synthetic crude oil. And of these, hundreds could be of a hydrocarbon nature.

There can be many confusing references to hydrocarbon contamination water. Terminology such as……..

PAH's (polycyclic aromatic hydrocarbons)
BTEX (benzene, ethylbenzene, toluene, xylene)
TPH (total petroleum hydrocarbons)
TRPH (total recoverable petroleum hydrocarbons)
TOG (total oil and grease)
Organic vs. **Inorganic**

………all contribute to this confusion.

Generally, hydrocarbon contamination in water is directed to total parts per million (ppm) levels of the hydrocarbon in water. For example, a hydrocarbon level of 30 ppm in water could contain any number of compounds that total this 30 ppm; including compounds found in jet fuels, diesels, lubricating oils, etc.. In other words, the source of the hydrocarbon and the specific compound is not particularly targeted. It is the overall total of hydrocarbon compounds that is typically of interest.

A hydrocarbon can refer to a vast array of compounds, but a determination of a *contaminating* hydrocarbon will help to define this scope. As well, acceptable and available measurement techniques may define a contaminating hydrocarbon even further.

The three main classes of hydrocarbons, described in greater detail, are:

Aliphatics are open chain compounds, bonded in a linear fashion, and are saturated or unsaturated. Saturated (single bond) aliphatics are often referred to as paraffins or alkanes. Unsaturated aliphatics are known as olefins or alkenes (double bond), acetylenes or alkynes (triple bonds), diolefins or alkadienes (two double bonds), and alkatrienes and alkeynes (multiple double or triple bonds). Typical aliphatics include ethane, actelyene, and 1,2-butadiene, and the most popular; methane.

$$C \equiv CH$$

Fig. 1 Aliphatic Compound example: note the linear bond fashion that leaves the molecules open ended. This particular triple bond compound shown is named acetylene.

Alicyclics, as indicated by their name, contain rings of carbon atoms in their structure. The ring size and number can vary which increases the number and classes of this compound. Multiple ring compounds are referred to as polycyclic alicyclic compounds. The saturated alicyclic hydrocarbons are often called napthalenes. Examples of alicyclics include cyclopropane and cyclopentane

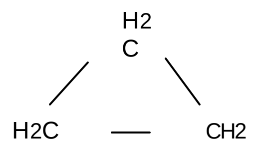

Fig. 2 Alicyclic compound example: note the circular (cyclic) bond fashion that leaves the molecules close ended. This particular compound shown is named cyclopropane.

Aromatics typically contain at least one 6-membered benzine ring in their make-up. Polycyclic aromatic hydrocarbons (PAHs) therefore include multiple ring compounds that include the benzine ring. As the name infers, these compounds typically possess a fragrance. A few aromatic compounds include ethylbenzine, vinylbenzine (styrene), toluene, xylene. The aromatics include what are often referred to as BTEX compounds.

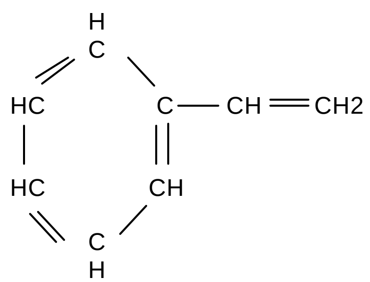

Fig 3. Aromatic compound example: note that a benzine ring (on the left) is in the make up of the compound. This particular compound shown is named vinylbenzene (styrene).

Most unrefined crude oil does not contain high concentrations of aromatic hydrocarbons. The aromatic hydrocarbons are typically the result of the refining process and are produced during the distillation (cracking) operations of a facility. Aromatics are therefore commonly associated with gasoline, jet fuels, diesel, kerosene, lubricating oils, and transformer oils.

As such, the aromatics are typically the target of monitoring instruments to verify distillation efficiency, filtration and separation effectiveness, and environmental contamination.

Regulatory Efforts

Environmental interest groups, government bodies, regulatory agencies, and of course, the general public and private industry itself all have a legitimate concern with regards to hydrocarbons in water.

On a global perspective, agencies such as the International Maritime Organization and the World Health Organization, have an interest in the overall quality of water, especially since water contaminants and their resulting affects do not respect international borders. Various international conventions have enacted regulations with regards to hydrocarbon contamination in water.

On a national scale the Environmental Protection Agency (USEPA) and the American Petroleum Institute (API) in the United States, Environment Canada, and the Ministry of Water Resources in China are examples of government and private bodies that are active in the participation and support of standards and methods of monitoring hydrocarbons in water. Within the world, any number of countries or groups of countries could have monitoring initiatives in place that are independent of international policies.

At state, provincial, and municipal levels of government, issues regarding water contamination are also evident. It becomes obvious at the municipal infrastructure level that a local water treatment facility would not want to be burdened with abnormally high levels of hydrocarbons in water that could upset normal treatment operations for drinking and recreation waters.

When water is used by, or comes in contact with a private or public activity, it is the responsibility of that activity to ensure that any hydrocarbon levels in the water effluent are within the guidelines determined for the recipient use. Use caution, there may be several jurisdictions with interests in one specific point of contamination.

Review of Monitoring techniques

There are a few different techniques available to determine hydrocarbon levels in water. Technologies that are restricted to laboratory use may provide the most valuable data, but are not favorable to field use where fast reading times are critical for the management of an effective processing and effluent operation.

For contamination purposes, the USEPA determined that hydrocarbon extractables could provide a basis to the measurement of ppm levels of hydrocarbons in water (EPA Method 413.1).

Originally freon was used to extract the hydrocarbons from the water. Once extracted, these could be quantitatively analyzed to provide an indicator of the ppm (or mg/l) of hydrocarbon in water. Atmospheric ozone depletion through the use of freons is changing this method towards the use of hexane (EPA Method 1664). This method readily provides the user with a hydrocarbon sample in the field. Basically, this approach suggests that if a hydrocarbon can be extracted from water, it can, and should be, monitored.

This technique provides data from a sample drawn at a specific time. It does not provide a continuous, real-time indication of the hydrocarbon levels in a continuously operating process stream.

Generally, measurement techniques can be categorized as discrete sample or continuous on-line devices. Typical approaches to monitoring include:

- ***Gravimetric (weight)***
- ***Colorimetric***
- ***Infrared***
- ***UV Absorption***
- ***Nephelometry***
- ***Fluorescence***

Gravimetric: This technique of hydrocarbon determination is described under the EPA Method 413.1 which uses an extraction additive. Freon-113 is added to a water sample and a subsequent boiling off of the water and Freon leaves the oil and grease which can then be weighed. EPA Method 1664 uses n-hexane to extract the oil and grease to be weighed. This method allows the total oil and grease to be measured in mg/l. A sample must be drawn from the process and taken to a lab to perform the procedures. This is not conducive to field use because of the equipment necessary.

Colorimetric: This can be a direct scan measurement of the sample or can use a technique similar to gravimetric in that an extraction takes place. A catalyst is then added to the extracted mix which initiates a dramatic color transformation.

The resulting color can be compared to a color chart or analysed using a spectrophotomer.

This method provides a more direct approach than weighing which makes it more practical in the field. However, a data base of standards of colours must be collected for each different hydrocarbon and application. For example, a water test and resulting colour will not provide the user with a ppm level of hydrocarbons directly. The user must know what general type of hydrocarbon is in the water (ie. transformer oil) and then compare the colour to a Transformer Oil chart that has been previously documented. Portable, laboratory, and field colorimeters are available that will analyze the colour and compare it to a data bank.

Infrared: Historically, this has been a widely used method of measuring for hydrocarbons in water. This technique looks at the total number of hydrogen and carbon bonds and, through a pre-determined calibration input, provides a ppm indication of the total hydorcarbons.

Typical units are transportable and require a discrete sample input. On-line devices are also in practice that will provide a near continuous indication of hydrocarbons.

Infrared employs the use of energy absorption. Hydrocarbons absorb energy at a specific wavelength (3.4 micrometers) and the amount of energy absorbed is proportional to the amount of hydrocarbons. Since other materials also absorb energy in this range (including water), the oil must first be removed from the interfering background. An extraction, as described above is typically used for discrete samples.

On-line devices usually incorporate a submersed and specially coated fiber cable that draws the hydrocarbons from the water and onto the fiber for analysis. The fiber is then mechanically cleaned off prior to the next reading.

UV Absorption/Transmission: This is similar in approach to the infrared, however the hydrocarbons do not need to be extracted from the water. This makes the unit applicable to laboratory and on-line applications. Different compounds absorb UV light at different wavelengths. By emitting UV light at a specific wavelength into the water, the hydrocarbon level can be determined by measuring the amount of light absorbed (the inverse of the amount that is transmitted through).

While this technique is quite selective to hydrocarbons, there are organics such as bacteria and algae, as well as suspended particles, that will interfere with the the light transmission (and hence, absorption) measurement. Compensation, filtering, or frequent zeroing is therefore required in many applications.

Nephelometry: Also referred to as light scattering, this technique uses light intensity measurements through the water to indicate ppm levels of oil in water.

Oil in water can cause the light to refract (scatter) in a predictable manner that can be monitored. An increase in oil content causes a light intensity decrease directly across from the emitter and a light increase can be measured at a point of scatter. Measurements can be done at either point.

This technique provides a cost effective in-line measurement. The sample must be stable with regards to any other sources of interference to the light path. These can include suspended solids, other chemical compounds, and color additives that may cause the light to scatter and result in a false hydrocarbon reading. Compensation and filtering techniques are often used to offset any possible interference.

Fluorescence: This technique also uses a UV light source, however, the actual absorption is not measured but rather, the fluorescing characteristics of specific compounds is monitored. Fluorescence is a phenomenon whereby a portion of the absorbed wavelength in the targeted compound is re-emitted at a higher wavelength. When the water is excited at a specific wavelength of UV light, certain compounds, including hydrocarbons, will absorb energy. Even fewer compounds will re-emit this light at a higher wavelength. Hydrocarbon compounds will re-emit at a wavelength range that is unique to them. By measuring the fluorescence intensity at this wavelength, the ppm level of hydrocarbons can be determined. This approach makes the instrument very selective to hydrocarbons.

For benchtop units, an extraction of oil from the water can be used to provide accurate results to regulatory standards. Straight water samples can be inserted, making the unit an ideal screening tool to determine that hydrocarbons are present.

Fluoresence is available in laboratory and on-line instruments. Compensation and sample conditioning for background interferences is not typically used with on-line instruments. This allows continuous and instantaneous readings without consumables.

Other techniques: Radar, Microwave, Acoustic, and Capacitance are a few alternative technologies used in the oil/water industry, however, these are typically restricted to per cent levels (not ppm) of hydrocarbon content in water or are more suited to separated hydrocarbons such as slicks on bodies of water.

The Fluorescence Approach On-line

One of the favorable characteristics of fluorescence is that the UV source and the receiving monitor do not need to be in direct contact with the liquid.

A common concern in field instruments is the routine maintenance and cleaning of wetted components. In fluorescence, the UV lamp can hover in front of or above a passing sample and not actually touch it. Also, since fluorescence looks for light re-emitted from the hydrocarbon compounds, the hydrocarbons themselves will send the light back out of the water so it can be detected by another hovering (non-contacting) sensor.

For non-contacting systems, the instrument cannot return the water to the process under the incoming process pressure. The passing water must outfall to drain or be collected and returned to the process by pump or other discrete method.

The sensor response to hydrocarbons in water is continuous and instantaneous allowing operators to maintain ppm data over periods of time as well as interlock to controls for real-time response to changing or upset conditions.

Designs can be very simple and direct or include scanning optical devices to increase the selectivity to specific compounds.

The design approach of the fluorescence manufacturer will result in the resolution and praticality of the instrument.

A wide and open shallow stream provides a stable viewing area for a sensor. Suspended solids interference is negligable using this wide path approach due to the area vs. water depth ratio.

A thick free falling tube of water with a concentrated light source and receiver may offer a lower range but suspended solids and fluctuating water conditions can be more of an influence.

Summary

While the definition of an actual hydrocarbon may be quite clear, the definition of a hydrocarbon condition or contamination in water is not as clear.

The type of hydrocarbon and the ability to reliably monitor for it within practical means plays an important role in this definition.

Measurements should be made within an industry standard to provide a common ground for comparison and discussion. However, each individual user will need to determine the technique that is best suited to their specific application.

The decision may in fact, be a combination of units. For example, a fluorescence on-line may be best for continuous use and process monitoring, but a calibration and routine check against a benchtop extraction would provide complimentary and verification data. For regulatory requirements, gravimetric measurements may also be necessary on a determined frequency.

Easily accessible parts for any cleaning is a prerequisite. And of course, inexpensive and field replaceable consumables are also important.

For field instrument use, simple is typically better. A comfort level is required between the operator and the instrument. Without this, the unit will not be maintained properly and the data will be questionable.

2. Measurement Technique and What it Detects (1 page)

The HydroSense technique to determine hydrocarbon concentration in water is called Ultra-Violet (UV) Fluorescence. This is based on the measurement of light intensity re-transmitted by the water sample at a specific and higher wavelength than received.

Many common, and not so common, compounds have the ability to fluoresce light. Compounds can fluoresce when excited by light at one or more specific wavelengths. The HydroSense operates the filtered UV lamp at a wavelength which will provide a strong peak of response from hydrocarbons.

When water and any contaminants in it are excited at this wavelength, certain compounds will respond by re-emitting this light at a variety of different wavelengths. This re-emitted light from the water stream is then filtered again to only allow the wavelength through for which hydrocarbons are responsible. While most applications have a fairly stable background water make-up, interference contaminants can exist. These would be compounds that fluoresce in the same wavelength range as the hydrocarbons. However, the light filtering is quite selective to hydrocarbons in most applications. In cases of an interferent, the unit would be effective for general trending but may not be the most suitable technique for selective ppm recording.

The hydrocarbons that respond to the HydroSense wavelengths are generally within the aromatic class. Typically, these hydrocarbons will include one or more benzene rings in their make-up. Further, these are usually found with a carbon chain length of about C-5 to C-36 and include BTEX, crude oil, refined oils (lubricants, grease), gasoline, diesel, Jet A, etc.

Synthetic oils, vegetable oils, mineral oils, and animal fats inherently do not fluoresce at the targeted wavelength since they do not contain a hydrogen and carbon molecule. However, they may carry a dye or additive that does fluoresce in the same wavelength. In these cases, this interferent may be considered a tracer and could be used to monitor water contamination.

The ability of a hydrocarbon to emit light may vary according to it's structure. For example, 10 ppm of crude may fluoresce at a different intensity than 10 ppm of diesel. As well, there are many different structures of crude, each with it's own characteristic and fluorescing ability. For this reason, a site calibration is necessary to accurately tune the instrument measurement of light to an accurate ppm reading and output.

3. Hazardous Locations Use **(2 pages)**

Generally, there are 2 different terms used by industry to describe and designate the same hazardous location; Divisions and Zones. Both are in use at the present time.

There are further designations for the type and source of the explosive material. Class I generally applies to the HydroSense applications. This designates the source as a gas or vapor, as opposed to dust or fibers.

The correlation of Divisions to Zones is as follows

Zone 0 = Division 1 = explosive vapor is present continuously
Example: Vapor space in a fuel storage tank

Zone 1 = Division 1 = explosive vapor is present intermittently
Example: Air space outside of tank where spurious gas concentrations may occur regularly when filling or maintaining a tank or process

Zone 2 = Division 2 = Explosive vapor is not normally present
Example: air space outside of the general area of a process or where vapors are not released under normal process operations

The standard HydroSense is approved to CSA specifications for Zone 2 (Division 2) applications. This indicates that the unit does not have exposed arcing components or temperatures that can initiate an explosion. A Type 4X enclosure is acceptable in these areas.

If your area is Hazardous Location classified, you must first determine if a CSA approval is acceptable to your site.

If the CSA approval is acceptable, the unit may be used in Zone 2 or Division 2 areas without any additional protection. If your area is a Zone 1 (Division 1) classification, or if the CSA hazardous locations rating is not acceptable, a purging system may be applied to the HydroSense.

Purging, or pressurizing, is the act of de-classifying the inside of an enclosure by maintaining a positive pressure within that enclosure. In essence, the vapors outside of the enclosure cannot get into the enclosure to cause it to be hazardous.
This method, when used on the HydroSense, is based on the understanding that the water sample has a maximum hydrocarbon content of 2000 ppm. Applications that may introduce higher concentrations of hazardous materials into the sample stream may render the pressurization system ineffective.

You must now determine if your installation requires a European (Cenelec) approval or not.

If a European system is required, a Eex p purge system will apply. This will allow the use of the HydroSense in either Zone 1 or Zone 2 (Division 1 or 2) areas.

If a non-European system can apply, a purge will de-classify the space as follows:

If the existing CSA Zone 2 (Div 2) Approval is acceptable:

-HydroSense can be used in Zone 1 (Div 1) or Zone 2 (Div 2) with a YZ purge

If the existing CSA Approval Zone 2 (Div 2) is not acceptable:

-HydroSense can be used in a Zone 2 (Div 2) with a YZ purge
-HydroSense can be used in a Zone 1 (Div 1) with a X purge

Purging (pressurization) systems are available as a factory supplied accessory or can be purchased and installed by the customer from an independent source. Some modifications would be required by the customer if it was sourced independently. These include sealing the existing chamber vent ports, connecting an airway between the controller and chamber, and drilling the housing to accept the bulkhead fittings.

For any purging system, a continuous source of clean dry air (or inert gas such as nitrogen) is required.

Added benefits of a purge include a clean dry source of air surrounding the electronics, eliminating the affects of harsh or humid environmental conditions. As well, the continuous air flow will purge the sensing chamber of humidity caused by the open flow of the sample stream. -end-

4. Filtering the Sample (2 pages)

The HydroSense is designed to minimize the affect of suspended solids and turbidity through the use of the unique flow glass and the flow through system.

There are no mechanical movements, small diameter tubes, or flow restricting devices used in the HydroSense. The flow glass causes the water to sheen across a wide surface area with a depth of only a few millimeters. This large viewing area for the UV light vs. the minimal depth minimizes the influences of turbidity. The oil molecules do not have a good chance to 'hide' behind suspended particles. As well, the light path interference ratio to the large viewing area is minimized.

Should stream filtering be necessary due to a high volume or particles, algae, or debris, there are a number of mechanical methods available to filter or separate particulates prior to entry into the chamber. Use caution when considering these since they may also remove oil, resulting in a sample being measured that is not indicative of actual process conditions.

Hydrocyclone: This forces particulates to separate from the water by a centrifugal force as water is funnelled in a swirling action down a specially designed tube. The heavy particles separate out while the light and emulsified contaminants remain.

These are available for use with the pressure and flow available from the process or electric models are available. The flowrate required is quite high compared to the requirement of the HydroSense and a some of the flow will by-pass the HydroSense directly to drain.

Routine maintenance is not generally required.

Screen or Bag Fillters: These are economical and easily installed in-line. Models are available that have automatic backwash systems to periodically clean out the filter. Otherwise, a periodic maintenance program will need to be put in place to clean the filter.

As the filter traps debris, it will also start to trap oil. The sample to the HydroSense will not be indicative of the actual stream. If this occurs, the clean-out frequency should be increased.

Separators: A flow through separator relies on the natural separating properties of the sample to remove solids. The continuous flow enters a vessel of a size that will cause the sample flow to slow down considerably. Baffles will generally direct the flow up and down as it moves through the unit. This retention time spent in the separator allows heavy particles to fall and become trapped in the separator. Contaminants that are lighter than water will surface and also become trapped in the separator.

Any non-emulsified or free-oils will have a tendency to separate during this retention time. The separator design may allow these back into stream rather the retaining them.

5. Pumps and the HydroSense **(2pages)**

In some applications, a continuous sample stream to the HydroSense unit is not always available. The source may not be under enough pressure or may be from a pit, pond, or stream without enough head pressure to ensure an adequate flow rate to the unit.

For any monitoring device, it is best to minimize any mechanical interference within the sample stream in order to maintain the sample in a condition most indicative of the actual stream source.

When pumps are employed, use careful consideration in the type and its installation. To choose a pump, you will need to know the height from the source to the pump inlet, the horizontal distances, the tubing size, the flow rate desired (at least .5 liter/minute for the HydroSense), and the operating voltage. Make sure the pump components are designed for water and the contaminants you may have in your water. Discuss any suspended solids and grit that may be in the sample. Confirm if the pump location is in a Hazardous Classified area.

Progressive Cavity: These pumps provide a strong positive pressure and flow. A stream by-pass is required at the HydroSense to divert any flow greater than the HydroSense can accept. Otherwise, a pressure will continue to build in the line between the pump and the HydroSense. Alternatively, a speed control can be used to run the pump at the desired flowrate. These pumps are generally of good industrial quality and wear well under a continuous run operation. If the pump runs dry, the stator can heat up wear quickly. It will likely require replacement (Dry Pump Alarms can be installed in-line). The pump will usually require a prime prior to start-up. The action of the rotor through the stator can cause a shearing of the sample. This can change the make-up of the water and its contaminants. It can reduce the size of the oil droplets, which in turn will affect the reading of an analyzing unit.

Perilstaltic: This is a common pump style for intermittent use in water monitoring samplers and laboratory use. The sample stream does not come in contact with any components other than the inside wall of the tubing, which minimizes cross contamination. In wastewater applications, the continuous wear on the tubing requires frequent changing, particularly when there is grit in the water. Since the mechanical action is a pushing of the sample through the line, there is minimal physical affect to the water make-up.

Air Diaphram: These pumps are known for being very robust. They are typically self priming and can run dry without damage. A sample is not substantially altered since the sample is moved through the pump in a pulsing fashion. A dampener may be necessary or an extended length of flexible tubing to absorb the pulse action prior to the sample entering the analyzer. A continuous air source or air compressor is necessary for operation. The sample flowrate can easily be controlled by adjusting the air pressure to the pump. The pump is not dramatically affected by suspended solids and grit.

Magnetic Drive Pump: This offers strong suction lift and good chemical resistance. The magnetic drive minimizes component contact with the liquid. The unit can accommodate most suspended solids. If any contaminates in the water are tacky, the pump may require cleaning prior to use after being stopped. This is due to the non-contacting magnetics that drive the impeller. A fluid by-pass is often available directly on the pump to minimize any high pressure build-up in the outlet tubing.

Metering Pump: This pump provides an adjustable flow rate directly on the pump. The output flow is steady and controlled. It does require a prime which is done quickly and easily at the pump. Excessive grit can hamper the piston stroke of the unit, although typical suspended solids found in wastewater streams are easily handled.

When supplied with the HydroSense, an air diaphram pump is considered first because they can run dry, do not require a prime, can run continuously with little wear, and can be operated in Hazardous Locations. If an air source is not available, Magnetic Drive pumps have proven very successful for continuous operation in aggressive applications.

Ceramic Test Tile Standard **(2 pages)**

Background: With water measurement instruments, a scheduled frequency of verifying the units' operation is desirable. Under conditions where the sample stream is not normally contaminated, it is advantageous to have an alternate test source that correlates to the sensing parameters.

Calibration Standard: A calibration standard is often used by field personnel to confirm the operation of an instrument. This is a stable device or liquid that, when presented to the instrument, correlates to a known concentration of the target contamination. This Standard is typically used to replace the actual stream source to verify the complete sensing, electronic, and control functions of an instrument.

Ceramic Standard: The HydroSense uses a fluorescence technique to measure hydrocarbon compounds within the water stream. The hydrocarbons induce a specific light intensity at a determined wavelength when excited with UV light.

By placing the Arjay Test Tile in place of the stream, the same response to UV light excitation is induced. The ceramic test tile contains the same fluorescing characteristics of hydrocarbons.

Accuracy Correlation: By placing the Test Tile into the unit, a system response will be initiated. This will confirm the units' ability to respond to fluorescing compounds, and confirm the electronic and control functions.

To further confirm the instrument accuracy, the Test Tile can be correlated to an actual ppm hydrocarbon value at the time of field calibration of the HydroSense. Upon completion of the HydroSense calibration, the tile is introduced to the unit and the ppm value on the display is read.
This value is recorded and is valid only for the instrument, site and water conditions at the time of calibration.

The Test Tile may now be used on a frequent basis to now determine the accuracy of the instrument based on this Test Tile value. Should the water parameters or the instrument hardware (i.e. Lamp) change, the Test Tile correlation would need to be redone.

The HydroSense accuracy should be verified annually against a laboratory and the Test Tile value confirmed.

A re-calibration of the HydroSense is necessary when the Test Tile response value or the laboratory test value is outside of the accuracy parameters set by the user.

7. HydroSense Partial User LIst

Consolidated Fuels	airport fuelling	wastewater	Canada
Ontario Power Generation			
Niagara Falls	power utiliy	cooling water	Canada
Thunder Bay	power utility	cooling water	Canada
Thunder Bay	power utility	cooling water	Canada
Sinopec	petrochemical	wastewater	China
NWT Power	power utility	wastewater	Canada
LVT Copperweld	metal fabricating	cooling water	Canada
Ford Motors	automotive	wastewater	Canada
China Power	power utility	cooling water	China
CanAmera Foods	food	cooling water (lake)	Canada
StoraEnso	pulp and paper	wastewater	Canada
Nova Chemical	petrochemical	wastewater	Canada
Chevron Production	offshore petroleum	produced water	USA
Chevron Chemical	Petrochemical	wastewater	China
AirConsul Aviation	airport fuelling	wastewater	Canada
Inland Technologies	plastic mfg	wastewater	Canada
Exxon	Offshore oil	produced water	Italy
Greater Nile Petro	petroleum	wastewater	Sudan
ProPak	Spill Clean up	Skid separator	S.America
PDVSA	petroleum	wastewater	Venezuala

Every application is different and the individual customer needs vary. The above installations are indicative of typical installations, however, are unlikely to mirror your application.

To help alleviate your concerns, Arjay will be pleased to discuss a Performance Guarantee and return policy to allow you to trial a unit prior to commitment. You will be responsible for shipping and installation costs.

8. SAMPLE SPECIFICATION for on-line ppm Oil-in-Water (Hydrocarbon) Monitor

The ppm Oil in Water Monitor shall be a continuous flow through type using a fluorescent technology that is selective to hydrocarbons in water. The operating range shall be user defined any where from 0 to10 ppm up to and including 0 to 500 ppm. The continuous sample flow will tap off the main effluent line and feed to the monitor under process pressure and flow rates. In cases where pressure and flow is not adequate, an approved pump is acceptable. The sample stream gravity outfalls from the monitor to a drain or return sump.

The sensor shall be a non-contacting type with no mechanical or pneumatic devices necessary to maintain a continuous on-line operation. The flow shall be directed across a sensing glass that has been treated to negate background interference due to any normal operational coatings on the glass. Suspended solids up to 400 mg/l shall have minimal interference with the output signal.

The controller shall provide a 4-line LCD display of ppm concentration, per cent of range, and bar graph simultaneously. The display will also advise of diagnostic and control functions. An isolated 4-20 mA output signal will be standard and it's range selectable through the keypad. Four 10 amp SPDT relays shall be available; two relays for alarm setpoints, each with full differential to eliminate control chattering and allow a concentrated stream to adequately clear prior to reset; one relay to alarm on a negative offset drift, and one relay to alarm on a maintenance requirement or fault condition. Relay time delay and output signal filtering shall be standard and selectable via the keypad.

For maintenance purposes, the lamp and any components requiring routine cleaning shall be readily accessible without tools and without having to shut off the flow through the unit. The relays can be manually disabled and re-enabled via the keypad during operational checks and other routine sump and pump interventions . The 4-20 mA output can be simulated through the keypad to set up and verify remote interconnected devices. Continuous self diagnostics will warn of a signal failure, negative offset drift, over-range, lamp failure, or calibration failure.

Calibration shall be done on-line and under normal process flow conditions. Unknown calibration values can be corrected to an outside laboratory result by a simple keypad entry.

The controller shall be housed in a Type 4X fiberglass reinforced polycarbonate enclosure separate from the chamber to allow easy installation in the field. A common mounting frame will be provided with the controller and chamber for wall or strut mounting. (Optional: The unit shall be housed in a SS enclosure)

The unit shall be CSA and UL approved for electrical safety and CSA approved for Class 1, Div.2 applications. (Optional: The unit shall bear the CE Mark and be housed in a SS enclosure)

The system shall be the HydroSense Model 2410 as available from (rep name and Telephone)

9. July, 2001   Sample Quotation to XYZ Int'l Inc.

For: HydroSense Model 2410 ppm Hydrocarbon in Water monitor

1. Model 2410-FT   HydroSense with Glass Flow Tile Chamber
-0-500 ppm hydrocarbon range
-0-400 mg/l suspended solids minimal interference
-accepts continuous non-intermittent flow only

Part #A00482	**SS housed unit with CE Declaration**	**US$ xxxxxx**
Part #A 00483	**Polycarbonate housed unit without CE**	**US$ xxxxxx**

Upper Control Panel with:
-LCD display of 0-500 ppm level and diagnostics
-4 alarm relays (2 for maintenance, 2 for setpoint alarms)
-4-20 mA isolated output
-115 vac or 220 vac power input
-Electrical Safety: CSA, UL, IEC
-Hazardous Rated: CSA Div 2 (Zone 2)
-wall mount enclosure

Lower Flow Chamber with:
-minimum flow rate 1 liter per minute, minimum 2 psi
-gravity outfall to drain or sump

2. Model 2410-OF HydroSense with Overflow Sample Chamber
-0-100 ppm hydrocarbon range
-suspended solids interference approximately +/- 1 ppm per 1 mg/l
-accepts continuous or intermittent sample flow
-continuous 30 psi fresh water source required for cleaning purge

Part #A00484	**SS housing, unit with CE Declaration**	**US$ xxxxxx**

Upper Control Panel with:
-LCD display of 0-100 ppm level and diagnostics
-4 alarm relays (2 for maintenance, 2 for setpoint alarms)
-4-20 mA isolated signal output, 220 vac power input
-115 vac or 220 vac power input
-Electrical Safety: CSA, UL, IEC
-Hazardous Rated: CSA Div 2 (Zone 2)
-wall mount Stainless Steel enclosure

Flow Chamber with:
-minimum 2 liter/minute, 0 psig
-gravity outfall to drain or sump

Options and Accessories

A. Purge/Pressurization Systems

Note: The standard HydroSense includes CSA Zone 2 (Div. 2) Approval markings. The CSA mark may be considered when determining the HydroSense use in hazardous classified areas.

1. Pepprl + Fuchs YZ Purge #A00485 $US xxxxxx
-allows use in a Zone 1 area by customer accepting CSA Zone 2 Hazardous Location Approval or
-allows use in a Zone 2 area based on the standard HydroSense CSA/UL/IEC safety approval

2. Pepprl + Fuchs X Purge #A00486 $US xxxxxx
-allows use in a Zone 1 area based on the standard CSA/UL/IEC safety approved HydroSense

3. Pepprl + Fuchs Eex p Purge #A00487 $US xxxxxx
-allows European use in Zone 1 and Zone 2 areas based on CSA/UL/IEC safety approved HydroSense

B. Site Assistance, Training, and Operating Spares

1. Field Site Assistance #A00488 $US xxxxxx plus $xxxxxx/day on site
-includes airfare based on advanced booking and travel (based on site within 4 hour drive of international airport)
-includes accommodation at standard international hotel or site by customer
-recommended 2 days site time for inspection, training, calibration, and operation confirmation (based on unit installed and operational prior to arrival)

2. Customer Acceptance and Training at Arjay factory #A00489 $US xxxxxx/day
-Location: Oakville (Toronto) Canada
-all travel and lodging expenses by visitor(s)

3. Recommended Spare Parts for 2 years operation

# A00114	**UV Lamp**	**$US**	**xxxxxx**
# A00142	**Glass Flow Plate**	**$US**	**xxxxxx**

C. Sample Handling Equipment

1. Husky Air Driven Pump and sump basin tube assembly $US xxxxxx
-air operated diaphram pump
-15 gpm @ 100 psi
-4.5 m lift

-foot valve and strainer assembly
-30m , 1½ teflon lined tube with fittings
-note: continuous supply of minimum 80 psi clean air required at site

2. Lakos Centrifugul Solids Separator **$US xxxxxx**
-minimum flowrate 4 usgpm, maximum 10 usgpm
-minimum inlet pressure 30 psi, maximum 150 psi
-1/2" npt inlet and outlet
-316 SS construction

3. Sentry Sample Cooling **$US xxxxxx**
-sample connection: 3/8" OD tube
-316SS wetted parts
-maximum pressure: 5,000 psi
-cools to within 3 degrees of cooling water
note: continuous supply of cooling water required

4. FluoroCheck 2000 Benchtop Monitor **$US xxxxxx**
-ppm fluorescence monitor
-based on EPA 1164 extraction technique
-discrete sample input
-for periodic calibration check of HydroSense and to support other customer samples and testing

5. Instrument Hut **$US xxxxxx**
-heated walk-in fiberglas hut
-1.2 m x 1.2 m x 2.0 m high
-for mounting on customer pad

6. Heated Stainless Steel Enclosure **$US xxxxxx**
-36" x 36" to accommodate standard fiberglas HydroSense
with additional mounting space for pumps, etc.

FOB:
Terms:
Taxes:
Weight:
Delivery:
Warranty:

10. HydroSense Application Data Sheet (3 pages)

Please fill in as much information as possible. Some information is required to determine the suitability of the instrument. Other information will help us understand your application better. We may be able to provide some further installation and monitoring guidance.

1. **Agent/Representative**______________________________
2. Prepared by______________________date____________

3. End User Information

Name: _________________________

Address: _________________________

Site: _________________________ Contact__________________
Tel:______________________

4. **Application Description** (brief overview of process and reason for monitoring the water for hydrocarbons)

____
____
____
____
____
____

5. Water Source Description

__ sump pit __process tank __process pipe __vessel __ditch __open channel __separator __well __offshore platform __cooling water pipe __other____

6. **Water Type**

__storm water __waste water __treated water __process water __cooling water__condensate __drinking water __sewer __ground water __sea water __distilled water ___produced water
__other____

7. **Compound to be monitored** (describe the contaminant, chemical name, structure, source etc.)

____

minimum ppm to be measured______, maximum ppm to be measured____

8. Are there other contaminants or products in the water ?_______
   Describe____
   Do they vary in their concentrations ? _______
9. Is there any colour in the water?_______Describe____________________________
10. Are there any suspended solids (turbidity) in the water ?_______
    What range?_________________
    Describe____

Process Information

11. Is there a continuous sample flow available to the HydroSense? _______
12. What is the flow range ?_______________
13. What is the pressure in the process ?______
14. What is the pressure in the stream line to the HydroSense?______
15. Can the sample stream outfall from the HydroSense go to an open drain or containment? _____
16. Is the sample stream pumped from the process source to the HydroSense? ______
    If yes, what type of pump ? _____________________________
17. What is the process stream temperature range___________
18. What is the HydroSense enclosure location temperature range_________

19. Area Classification of HydroSense installation:
20. General Purpose Type 12___Type 4___
    Hazardous Zone 0___Zone 1 (Div 1)___Zone 2 (Div 2)___
21. What is the input power available? __24 vdc __110 vac __220 vac

22. Are the relays being used?
    Describe____
23. Is the 4-20 mA output being used?
    Describe_______________________________________
21. Do you presently have grab samples tested? __laboratory on site __send to outside lab. What technique and compounds are measured ?
____
24. Does the process ppm concentration vary on a regular basis ?_________
25. Do you have the ability to force a change or make up a ppm in water sample for calibration purposes ? ____
26. Is the monitoring intent to determine an upset condition or to record and evaluate actual ppm levels?
    Describe____

Make a quick sketch of the process overview and HydroSense Location

10. HydroSense Installation Notes **(3 pages)**

IMPORTANT: Read these notes ***before*** installation.

The system is comprised of two main components, the Sample Chamber and the Monitor.

1.0 Sample Chamber

1.1 The Sample Chamber receives the flow sample from the process and outputs it to drain. The chamber should be wall mounted on a vertical plane to allow a proper flow through the sensing unit. A bubble level is included inside the chamber to assist in mounting the unit correctly.

1.2 The Sample Chamber should be located close to the process to reduce the lag time of the sample to the unit. This will offer more instantaneous readings and real time recording.

1.3 The outlet gravity flows to drain, and consideration to the close proximity for this effluent is important. Also, mount the unit where it is readily accessible for maintenance and periodic testing by manual insertion of known samples.

1.4 If the process is not under a flow pressure, the chamber should be mounted below the process level so the sample can free flow down and through the unit. A pump may be used. The maximum input pressure is 100 psi. The Minimum input flowrate is 800 ccm (.238 us gpm)(.9 l/m)

1.5 The inlet connection to the unit is a 3/8" female thread. A barb connection may be threaded to this when flexible inlet tubing is used. Clear flexible 3/8" or 1/2" inlet tubing is suggested for the inlet sample. This will provide a visible indication of the sample, as well as an indication of contaminant build-up. To minimize the contamination in the tubing, Teflon lined tubing may be desirable. Note: Clear tubing should not be used outdoors where algae build-up from sunlight is increased.

1.6 An on/off valve at the process is recommended to shut down the system for maintenance and/or sample tube replacement. (An on/off valve is included within the unit for throttling flow. This can be used for internal maintenance).

1.7 The sample gravity flows out of the Sample Chamber. The outlet tube **must** only be installed in a downward vertical or downward graded horizontal direction. Any upward direction will cause the sample to back up and flood the sample chamber.
1.8 The outlet fitting is a 3/4” female thread. Pipe or tubing of 3/4” sizing is recommended. The outlet tube should never be under 1/2”. This will cause a restriction and flood the system.

1.9 The outlet of the tube should be open to air, **not** submerged in water or a process which would cause a back pressure. This would result in the sample chamber flooding.

1.10 The Sample Chamber must be mounted indoors or in a heated housing to avoided sample freezing. The inlet and outlet tubing must not be exposed to freezing environments.

2.0 Monitor installation

2.1 For greater accessibility and ease of testing and calibration, the monitor should be mounted adjacent to the sample chamber. The interconnect wiring between the monitor and the sample chamber is a 13 conductor, 24 AWG shielded instrument cable. The unit is supplied mounted on an aluminum plate and wired to the chamber. These may be separated if desired. Use 16 AWG shielded wire. Maximum distance 100 meters.

2.2 The Monitor operates using 115 VAC, 50-60 Hz, 10 watts maximum input power (optional 220 VAC, 50Hz or 24 VDC).

2.3 The monitor is used for display and calibration, and should be mounted where it can be readily accessed and is easily visible.

2.4 The monitor provides LED indication of relay status for Lamp Replacement (Relay 4), and alarm levels (Relay 1 & 2). Relays are included for these controls for remote annunciation. The relays are dry contacts and will accept AC or DC inputs.

2.5 A 4-20 mA dc output signal proportional to the PPM levels is provided. This is a non-isolated signal capable of driving 1000 ohms. The remote indicators, receiving devices and their distances should be considered when choosing a location for the Arjay Controller.

2.6 Shielded wiring is recommended for the output alarms and signals to avoid EMI and RFI interference from other equipment near the sample unit.

2.7 The Monitor is housed in a Nema/Cema 4X Fiberglas reinforced polycarbonate enclosure. Extremes in temperature and humidity should be avoided. Indoor installation or a heated instrument housing for outdoor use is required.

12. INTERFERENCES and AFFECTS TO ACCURACY

The UV fluorescence technique monitors the intensity of light emitted from the passing stream at a selected wavelength band.

This technique can be quite selective by eliminating the light affect of compounds in the water that do not share the same fluorescence characteristics of hydrocarbons;

1. When chemical compounds in the water are excited with light energy, only certain compounds will emit the light back out of the water at a higher wavelength than excited with. These are referred to as fluorescing compounds. The HydroSense does not respond to most chemicals because it only responds to fluorescing compounds, of which aromatic hydrocarbons are included.

2. The light used to excite the compounds is filtered to 254 nm +/-. Of all the fluorescing compounds only certain ones will respond to this wavelength. Some respond to higher and some to lower wavelengths. This filter narrows the HydroSense response further to only those that fluoresce from 254 nm +/-.
3. These limited number of compounds that do fluoresce from 254 nm light may emit light at any number of wavelengths such as 290nm, 310 nm, 350 nm 480nm, etc. Aromatic hydrocarbons happen to fluoresce at approximately 350 nm. By filtering the light sensor from all light except 350 nm +/-, only compounds the emit light at 350 nm +/- are picked up by the receiver.

4. Oil and Grease in water may be made up of hundreds or thousands of different hydrocarbon compound structures. The aromatic compounds tend to be the fluorescing compounds. The proportion of aromatics within the total hydrocarbons is generally consistent in a product or process. The aromatics are therefore used as an indicator to correlate the monitor to total hydrocarbons in water.

Changing Oil Types and Sources

Different oils have a different make-up of compounds and the fluorescing strength may vary between oil types. For instance, diesel fuel may fluoresce much stronger than transformer oil. If the HydroSense is calibrated using 100 ppm of diesel, 100 ppm of transformer oil may only give a display reading of 95 ppm.

Crude oil may vary from one well to another, lubricating oils from different manufacturers may vary in their make-up, oils may be dissolved or free, and so on.

The calibration is therefore site selective and should be done using actual process water or with samples of oil that are to be targeted by the monitor. The calibrated accuracy relies on the oil type and conditions being consistent. The HydroSense will respond positively to aromatic hydrocarbons but the display accuracy may be affected by variations in the types and sources of these hydrocarbons.

Other Chemicals in the Water

The light sensor is selective to compounds in the water that emit light at 350 nm when excited from 254 nm light. If there is a background chemical in the water that fluoresces at these wavelengths, the Hydrosense will respond to them. If this background chemical concentration is consistent, this interference will be zeroed out during calibration. Calibration is recommended using process water so that any background interferents are zeroed out.

If an interfering background chemical changes in concentration, the HydroSense will sense this change. Consideration to this affect is important for alarms and recording. Filtering of the water, changes to chemical use, or special light filtering may be required to provide more stable readings.

The periodic introduction of fluorescing chemicals into the water may also affect the reading. During these conditions, operators and alarms should be acknowledged that nuisance alarms may occur. Soap manufacturers will often include fluorescing dyes in the product for appearance and identification. Green dyes are typical in industrial degreasers and commercial soaps. Fluorescing chemicals are often included in detergents to enhance the visual affect of a cleaned product such as clothes.

Not all of these commercial dyes will affect the wavelengths of the HydroSense, however, green dyes have proven to be a common interferent.

Suspended Solids and Turbidity

The unit is calibrated to a passing stream of water. The amount of light fluoresced by the aromatic hydrocarbons determines the calibration parameters. The light received by a hydrocarbon and then sent back to the receiver is based on a stable light path through the water. If suspended solids or turbidity block the light getting to the hydrocarbon, light cannot be fluoresced back to the sensor.

Readings can be dampened by an increase in solids or turbidity. When process water is used during the calibration, the offset affect of solids is taken into account and zeroed out.

The design of the large surface sensing area of fluid verses the small sensing depth minimizes the affect of turbidity in the HydroSense. In effect, the hydrocarbons have little place to hide behind solids. In circumstances of dramatic changes in turbidity, sample conditioning techniques prior to the HydroSense should be considered.

13. ROUTINE CLEANING PROGRAM

The HydroSense relies on a constant flow of water across the sensing plate. Excessive particulates and algae in the water can build up on the glass and in the overflow weir. This will eventually affect the performance of the unit. Setting up a Routine Cleaning Program is vital to the successful performance of the unit.

Each application will vary in the frequency of cleaning. Some may require daily wipes and some may require monthly cleaning. A basic wipe down of the glass can be done without having to shutdown the stream or power. The wipe procedure will take 2 to 3 minutes. The overflow weir will need cleaning out as indicated by observation of the build-up.

To set up a schedule, it is recommended to program a daily wipe of the glass using a clean paper towel. Observe the weir flow for any particulate build up and clean out if necessary. After two weeks of daily cleaning, determine if every other day may be adequate. If so, set this program in place for two weeks. Slowly extend the frequency between cleanings until an adequate program frequency is determined for your individual site conditions.