MONITORING PROCESSES IN TECHNOLOGICAL CONTAINERS

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Abstract

The author of the article proposes a monitoring technique of a process vessel entire working volume by means of a special measuring module. Modern production requires a qualitative, uniform throughout the volume of capacity, the technological process. The article is recommended for engineers involved in controlling of technological processes physical parameters in modern automated production.

During working cycle of flow of processes in technological reservoirs, whether it is an experienced test bench or production units, issue of improving accuracy of measured parameters is urgent in all areas of liquidity [1]. Constant, ubiquitous monitoring of these parameters and the relationship between, directly, sensors and control units constitute a necessary condition for measurement accuracy.

A significant amount of monitoring falls, of course, on the directly measured parameters, signals, with values of which come from the respective sensors. Also, in some cases it is possible and expedient to measure also indirect parameters, which makes it possible to calculate values whose measurement is difficult.

In general, in production, in technological reservoirs there are usually areas, the dynamics of processes in which differ significantly from the dynamics of processes in other, more active areas of technological capacity. Such activity is due to the circular movement of liquids.

Processes, chemical reactions in different turbulent areas occur with a difference, and the results of measurements can vary significantly [2].

In some cases, it makes sense to use an alarm system, the role of which is to notify in case the measured parameters go beyond threshold values.

An extremely important issue is the possibility of equalizing the process parameters in all areas of the reservoirs. Indeed, during the working cycle chemical reactions are possible, and they require control [2, 3]. The goal is exactly the same quality technological process in all areas of the reservoir.

To control the chemical – reactionary activity of the whole volume of the process liquid and, as the circumstance arises, to level all working parameters of the basic process, as well as to secure equal duration of the high-quality process procedure in all points of the process liquid operating volume, a sensor module in form of a hub is assembled based on the present-day developments and alternatives of the touch free sensing technology, which houses the sensor — a solenoid of a determined configuration (figure 1).

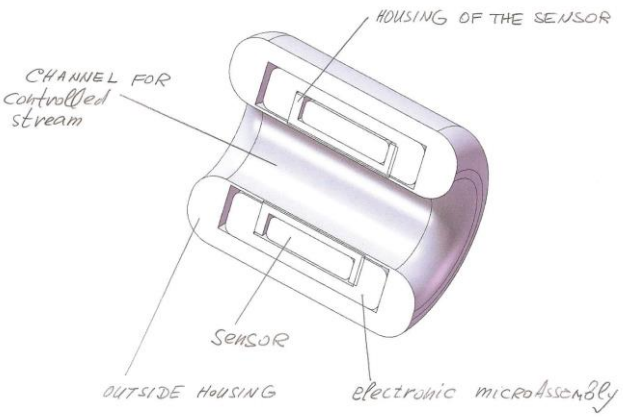

Figure 1. Sensor module with built-in measure

First of all the sensor module gets the shape, fully complying with the main properties of liquids, engaged in the manufacturing procedure, started in the reservoir.

Thus, the sensor module has a shape of a hub, which faces have rounded joints, and together with the cylindrical part of the hub make toroid-shape inlets into it.

Semi-diameters of the toroid-shape surfaces depend on the monitored fluids viscosity and are executed not to create hydraulic resistance and not to slow down the liquid flow through the internal hole of the hub [4,5].

Height of microroughnesses of all internal hub surfaces is minimum to decrease additionally the mechanical resistance to the monitored liquids flow through the hub of the sensor module[4] (figure 2).

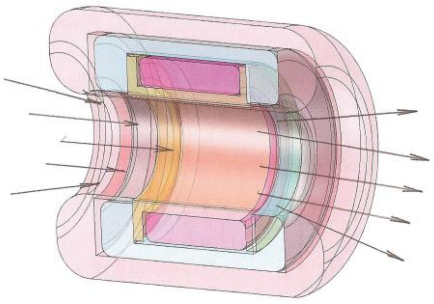

Figure 2.
Fluid movement through the sensor module.

Thus the sensor module is adjusted to definite conditions in the reservoir.

To initiate automated monitoring of the required parameters in all process phases, the respective mathematical models are needed for both the process parts and the response of all system elements to impedance resonant background around the sensor module [2,6].

The sensor module has two versions; the 1st version is installed directly in the industrial pipeline ahead of the inlet to the reservoir displacement volume inside the manufacturing facilities (figure 3); the 2nd version is portable, designed for sampling of the process medium or mixture of the process mediums from the dead zones of the reservoir into the section of the pipeline with the installed sensor module.

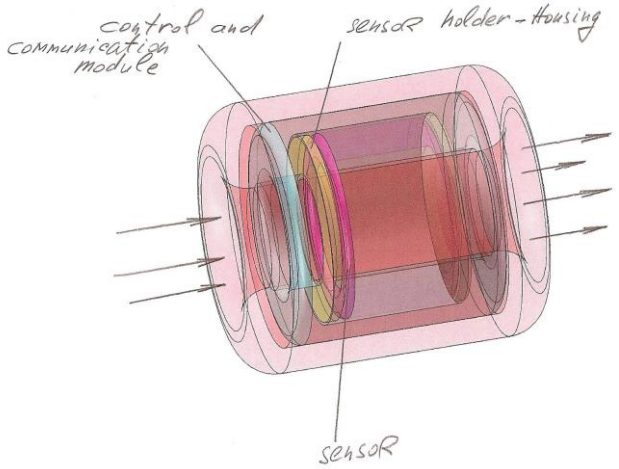

Figure 3. Sensor module

Both versions of the product (sensor module with complete required internal and outer infrastructure) have simple clean design, made of plastic, usually polyvinylchloride, are compact and easy to use.

Operation principle for both versions of the device is based on comparison of model signals of the resonance sensor with the signal of sampling measurement; the model signal is obtained in the multi-component or water solution, fully complying with the standard requirements [6].

The sensor module sensor (figure 3) together with the supplementary sensor devices equipment states the slightest deviations from the model signal, Detection threshold [6]:

- for organic acids and compounds, including phenols and traces of the surface-active substances, detergents and mineral fertilizers — 0.0000001 grams;
- for metals is 0.000000005 grams;
- for radioactive isotopes — 0.000000000001 grams;

The sensor (sensor module) in the primary version does not separate and fix selectively pollution or impurities components, but thanks to its sensitivity, it identifies 55% threshold of components and ingredients, pollutions in portable or process water, dangerous for operating procedure accuracy or its' purity and stability. Such high accuracy of the stand-along manufacturing device (sensor module) assures continuous control of process quality, quality of water, used for manufacturing purposes, and allows taking effective corrective measures prior to attaining of dangerous level of pollution or impurities concentrations.

All the electronic circuit boards and the micro modules of the sensor module system should have maximum response rate with no extra power resources involved.

As the electronic sensor module should operate in a standalone mode, most probably the system, based on the dimensional selective metal etch process technology, can implement compliance with all requirements and system conditions [6].

The author deems it necessary to give an example of such a through technological procedure, governing possible creation of module for installation, cooling, operation and control of energy consuming optoelectronic systems.

Ordinary process of this type comprises brand-new elements with the below stages of component processing:

— Steal strap (coil) surface preparation;

— photoresist coating (photoresist with highly acutance);

development of photoresist;

— rapid jet electrochemical coating of nickel (2-3 microns width);

— rapid jet electrochemical coating of copper (25–35 microns widths);

This technology phenomenon is the main difference and grants a set of efficient method advantages. The author provides some explanations and gives definition of this phenomenon.

Rapid jet electrochemical coating is a rapid galvanic process in the selectively aligned directed flow of electrolyte, with the cyclic recirculation system of electrolyte refreshment, which comprises: reservoir with electrolyte with definite controlled and adjusted parameters of the electrolyte content mode in respect of:

- nickel and cooper concentration
- temperature
- acidity level
- density
- conductivity

(thanks to technology advantages there is no need of use of organic additives – brightener)

The system also comprises:

- pump
- filter
- anode for jet metal coating with components, soluble and insoluble in this type of electrolyte, installed successively in the direction of the electrolyte flow, at this:
- the insoluble component is made of composite, carbon-graphite conductive cloth, and is located parallel to metallized area, last in the direction of electrolyte flow and first ahead of the coated surface (cathode). Additionally, both components are connected to an electropositive potential and have selective adjustable penetration for electrolyte.

The anode has the system of electrolyte equilibrium distribution on the soluble component surface, which automatically occurs in the insoluble component, and consequently, on the metallized area – the cathode.

These are the below processes:

— photoresist removal

— metal etching on one side mid-width of the steal strap

— removal of etching products from the surface by aerodynamic and following hydrodynamic drag (a separate innovative technology)

— pressure test of fluid polymeric composition in the following order—

— monomer pouring

— consequent polymerization

— thermostabilization

— metal etching from the 2nd side (with the same differences)

— pressure test from the 2nd side (with the same differences)

— protector coating on current conductive structures

— vacuum coating of all heat-conductive structures with layer-type system of semi-conductive nanostructural polycrystalline diamond films

Health service standards and technological standards of the majority of the developed countries recommend continuous quality monitoring of components and materials, used in operating procedures, and implementation of this requirement often faces commercial unavailability of a reliable, easy to use and accurate device (analogue of the suggested standalone sensor module), which price permits its large scale acquisition and application.

The versions of the sensor module, offered as per the ideas of the present paper author, fully comply with the standard requirements both for applied materials safety and application output.

Both versions of the device are easy to manufacture, do not require use of any specialized technologies and can be produced in small and medium enterprises.

Annex 1

United States Patent Application	20130178721
Kind Code	A1
	July 11, 2013

VIVO DETERMINATION OF ACIDITY LEVELS

Abstract

A bolus for use in a ruminant animal's reticulum includes a cavity (100) configured to receive ruminal fluids present in the stomach. The cavity has walls (110) of a dielectric ma- terial and is encircled by a coil member (120), which is configured to subject the ruminal fluids to an electromagnetic field. A Sensor element (310) measures the electromagnetic field's influence on the ruminal fluids and thus register an electromagnetic property representative of an acidity level of said fluids. A transmitter (410) transmits a wireless output signal (SD) reflecting the acidity measure.

Annex 2

United States Patent Application	20130173180
Kind Code	A1
	July 4, 2013

DETERMINATION OF ATTRIBUTES OF LIQUID SUBSTANCES

Abstract

A monitoring unit (100) that determines parameters (p1, p2) of an attribute (P) of a liquid substance flowing (F) through a dielectric conduit (110) includes plural coil mem- bers (121, 122) encircling the dielectric conduit (110) that subjects a flow of the liquid substance to plural different elec- tromagnetic fields (B(f)), and under influence thereof mea- suring circuitry registers corresponding impedance mea- sures (z(f)) of the liquid substance. A processor (130) derives the parameters (p1, p2) of the attribute (P) based on the reg- istered impedance measures (z(f)).

Annex 3

United States Patent	8,694,091
	April 8, 2014

In vivo determination of acidity levels

Abstract

A bolus for use in a ruminant animal's reticulum includes a cavity (100) configured to receive ruminal fluids present in the stomach. The cavity has walls (110) of a dielectric ma- terial and is encircled by a coil member (120), which is configured to subject the ruminal fluids to an electromagnetic field. A Sensor element (310) measures the electromagnetic field's influence on the ruminal fluids and thus register an electromagnetic property representative of an acidity level of said fluids. A transmitter (410) transmits a wireless output signal (SD) reflecting the acidity measure.

Annex 4

United States Patent	9,316,605
	April 19, 2016

Determination of attributes of liquid substances

Abstract

A monitoring unit (100) that determines parameters (p1, p2) of an attribute (P) of a liquid substance flowing (F) through a dielectric conduit (110) includes plural coil mem- bers (121, 122) encircling the dielectric conduit (110) that subjects a flow of the liquid substance to plural different elec- tromagnetic fields (B(f)), and under influence thereof mea- suring circuitry registers corresponding impedance mea- sures (z(f)) of the liquid substance. A processor (130) derives the parameters (p1, p2) of the attribute (P) based on the reg- istered impedance measures (z(f)).

Annex 5

United States Patent Application	20120029845
Kind Code	A1
	February 2, 2012

APPARATUS AND METHOD FOR FLUID MONI-
TORING

Abstract

According to some embodiments, an apparatus and method are provided for detecting the composition of a fluid. An alternating electromagnetic field may be applied to the fluid and distortions in the electromagnetic field are compared with predetermined, expected distortion «signatures» for particular components at particular concentrations. The presence and concentration of the components in the fluid may be detected by detecting these distortion signatures.