The contamination of the environment has drawn the attention of society and waste. The increasing use of pesticides in the management of livelihood and the quality are of fundamental importance for freshwater resources amount to 3655 km³ 842 km per year which is by far the highest inland area designated as “Drought Polygon” (occurrence of droughts) is estimated at 1,083,790.7 km². It is estimated that only 18% of the area occupied by naturally saline soil is more than 90,000 km², predominantly within the Drought Polygon.

Besides, the growing demand for water in industrial processes may affect the local environment in a significant way. Likewise, water scarcity, especially in the semi-arid northeast of Brazil, makes water reuse a factor of high priority and attractiveness [3].

Thus it is important to have methodologies to assess the impact of agricultural activities on soil and water. More specifically, in the case of applications of inputs such as fertilizers and pesticides (herbicides, insecticides, fungicides), and substances such as nitrates, nitrates, heavy metals, ions and humic substances, it is essential to constant monitoring of the environment in order to know well the effects and destination of such products in natural resources [4, 5]. In this case, the tests are almost always expensive and require the use of sophisticated laboratory equipment. Therefore, the developments of sensors that allow the determination of these substances in the laboratory or field, with techniques of low cost and simple to perform, are highly desirable. An important feature of the monitoring and surveillance of these substances in the environment [6, 7] is the need for a large number of tests and measures, both spatially and temporally. To this end, we seek to increasingly sensors, equipment and the most simple, cheap and fast. The study of conducting polymers has attracted an enormous scientific and technological interest due to the need of active materials for sensors in many applications. These polymers become electroactive through the process of doping, with a variety of substances, which allows an increase of its versatility for use in sensor devices.

The potential impact of nanotechnology on the sensor market is huge in the developing and developed world alike. For example, industry analyst NanoMarkets reports that nanotech sensors generated global revenues of US$7.2 billion in 2008 and estimates it will reach US$22 billion in 2012.

In Brazil, The National Nanotechnology Laboratory Applied to Agribusiness, housed at Embrapa’s agricultural instrumentation unit in São Paulo, has developed a cheap optical sensor incorporating nano-assembled films to evaluate the acidity of natural water supplies. And ‘electronic tongues’ — another kind of polymer sensor developed at Embrapa — can be used to distinguish between different mineral waters and between pure water and water contaminated by organic matter.

New sensor technology could lead to tiny sensors, powered by micro and nanotechnology, be the best way to have sensors working with good performance and at lower costs. The techniques which usually achieve such systems are not so due high costs and many companies to build up such sensors. Meanwhile, and collaborators [12] developed a new line of sensors, the Line Patterning Technique, which are used to fabricate inexpensive, easy to manufacture and highly sensitive devices.
The pH of the water is an important parameter to water quality, because the value could determine the toxic effects of the substances found in the solution. (runoff from agricultural, domestic, and industrial areas may contain iron, aluminum, ammonia, mercury or other elements). The measurement of the pH in the water has high weight in the Water Quality Index (WQI). The WQI are compound by the following parameters: a) Dissolved oxygen; b) Fecal coliform; c) pH; d) Biochemical oxygen demand; e) temperature; f) total phosphate; g) Nitrates; h) Turbidity and i) Total solids. [22].

**Optical pH disposable nanosensor.**

The line patterning technique was used to make a mask to developing a low-cost optical sensor, built in the stripe of poly(ethylene terephthalate) (PET) film, using a thin film of polyaniline (PANI) in the emeraldine oxidation state [14-15] doped with HCl, by in-situ chemical polymerization. The measurements occurred with conductive polymers doped and dedoped, and were used to evaluate the pH of natural water. The absorption of UV-Vis spectra was investigated to evaluate the optical response of the pH change to natural water, and the comparison with common technique (Horiba system) used to measure the value of water pH in the natural condition. The sensitivity and reproducibility was evaluated.

In this paper are demonstrated the potential application of low cost sensor to investigate influence of ionic strength to desalinization investigation, carry out study of pH in natural water (limnologic and portable water), new other techniques to evaluate de concentration of pesticide in water (Electrochemistry and biosensor) and global water quality (electronic tongue).

**Materials and Methods**

**Development of optical pH sensor using Line Patterning Technique (LPT)**

The LPT was used to design the mask and polyaniline deposition. In the figure 1 the sequence for the manufacture of optical pH sensor: a) Design of the mask, b) negative image of the mask, c) printing of the mask on PET, d) in-situ synthesis of PANI, e) removal of the toner with toluene and methyl ethyl ketone (MEK).

The size of the strip was designed compatible with PET to the size of portable electronics. The size of the square to deposition of the active layer (PANI) was determined according to the place where the light beam will not be dispersed.

**UV-Vis spectroscopy of the PET/PANI stripe with different pH**

The spectrum of polyaniline obtained by chemical oxidation is pH dependent between a pH 2 -12. In this range the apparent pK is around 7; which is in the physiologic pH range. The electronic absorption band of polyaniline sensitive to pH change is very broad. The figure 2 showed the absorption response of the composite (in-situ deposition of polyaniline coated PET) with fifteen different pH (2.0, 3.0, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 9.0, 10.0, 11.0 and 12.0).

**Measurement in natural water**

The developed system was used to determine the pH of natural water dammed. The water used in the experiment was collected on January 6, 2009 at 16:30 in Carlos Botelho (Lobo-Broa) reservoir, Itirapina, São Paulo, Brazil. The reservoir is 11' 40.87" S, longitude 47° 52' 6.8 Km around 22 x 10 m. We col water samples at different places: 30 and 45 cm, to obtain the samples from the Lobo-Broa with the optical system. The PANI was maintained for five 1M HCl solution, and after dried the samples were measured with the optical system was compared with the values obtained with a colorimeter (Analion).
Results and Discussion

The colour of PET/PANI stripe is pH dependent, as the protonated and non-protonated forms of the PANI have different spectral characteristics. Fig. 4 shows the calibration curve that was obtained with the wavelength of 530nm. The reproducibility was tested, and value obtained for 6 different samples were 7.6% to the same wavelength. The sensitivity of the calibration curve, using a fourth grade polynomial equation, was approximately 0.4 of pH. The minimum measurement of the pH was 1.5 and the maximum was 11.9. The equation 1 is a linear relation of the attenuation (I/I) and pH. This is considered the calibration equation of PET/PANI stripe. The reproducibility was investigated and the standard deviation is considered the measured three times, with immersion time of 5 minutes each measure.

The optical device developed was used to verified the effects of the ionic strength and the nature of the ions, using buffer solutions in which different salts (NaCl and KCl) and three concentrations of 0.15, 0.30 and 0.50 mol l-1, with the solution in the same pH (7.0). Fig. 5 shows the relation between concentration (mol l-1) and attenuation response of PET/PANI stripe, obtained by using NaCl and KCl (in different concentrations).

The colour of PET/PANI stripe is pH dependent before measure the pH solution.

$$\text{pH} = 1.003 - \left\{ \frac{4.982 \times \log \left( \frac{c}{c_0} \right)}{c} \right\} + 0.9882 \quad (1)$$

Table I. Values of pH of water (Carlos Botelho reservoir) at various depths, obtained with the optical system and commercial electrode.

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>pH (commercial System)</th>
<th>pH (Stripe (PET/PANI))</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>7.2</td>
<td>7.5</td>
</tr>
<tr>
<td>30</td>
<td>7.7</td>
<td>7.9</td>
</tr>
<tr>
<td>45</td>
<td>7.6</td>
<td>7.9</td>
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</table>

The data were obtained in the field, during a rainy day, in 01/2009, 16:00hs. The measurement of the pH obtained in 15 cm was possible observe a slight trend to acid regime. This could be a influence of the rain in the first layer of natural water. In the depth 30cm and 45 cm basically the pH didn't change.

Application of optical pH in natural water

The pH of natural water collected from various depths, in Carlos Botelho (Lobo-Broa) reservoir, Itirapina-SP, Brazil, was obtained with the PET/PANI optical sensor. The pH of the water through the optical system was compared with measurement of the commercial pH meter. The data collected are showed in Table I. The proposed optical system has an accuracy of ± 0.4 pH units, the data obtained are in good agreement with the pH obtained with the commercial system.

Table I: Values of pH of water (Carlos Botelho reservoir) at various depths, obtained with the optical system and commercial electrode.

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The results obtained show us the potentiality to be used as disposable sensor to evaluate the influence of ionic strength, and can be applied to investigate the salt concentration in the water solution.

Enzyme inhibitors bind to and decrease their activity. Since an enzyme activity can kill a plant or correct a metabolic imbalance, drugs are enzyme inhibitors. Enzyme inhibitors are also used as herbicides and pesticides. Specific interactions between enzymes and particular drugs can be studied at the molecular level using atomic force microscopy (AFM). Adhesion, in particular, is governed by short-range intermolecular forces. Figure 7 shows the force between glass (substrate) and the tip of the Atomic Force Microscope (AFM) coated with enzyme (2,4-D carboxylase (ACCase)).

Figure 7. Force curve on glass and herbicide.

Electrochemical detection of pesticide using conducting polymers as sensors

Pesticides with acidic character (2,4-D, glyphosate and bentazon) are readily sorbed on the electrode surface as the pH increases. The voltammetric response of the CPE2 electrode. However, a different behavior was observed between acidic pesticides and the polypyrrole electrode.
The analysis of the data showed that could be useful to investigation in environmental condition.

Electronic Tongue water quality

An electronic tongue based on conducting polymers and a lipid-like material (steaeric acid, SA) can be used to distinguish between different mineral waters and between pure water and water contaminated by organic matter [20].

The importance of using ultrathin films in obtaining high sensitivity, detecting sucrose, quinine, NaCl, and HCl at the parts-per-billion (ppb) level. For that were compare sensor arrays made with nanostructured Langmuir-Blodgett (LB) films and cast films from conducting polymers, a metallic complex, mer-[RuCl (dpbb)(py)] (dpbb = PPh (CH) PPh ; py = pyridine) (Rupy), and mixtures of conducting polymers and Rupy. This could be indicate that the manipulation of composite Rupy/conducting polymer films may be tailored to specific applications, particularly because ruthenium complexes might complex with heavy metals [21].

Conclusions

The results obtained in this work indicate that the strip built with PET - PANI nanocomposite produced during in situ polymerization of aniline onto PET film, is suitable for a construction of disposable optical sensor, which could be useful to measure pH of the natural water, as well the ionic strength. The sensitivity and durability of each optical sensor were obtained from the experimental results. The analysis of the data showed that could be useful to investigation in environmental condition.

In addition was showed the potentiality of new techniques (Biosensor with AFM cantilever and Electrochemistry) applied to detection and quantification of herbicide in water, and electronic tongue to use in global water quality. In this paper was showed a brief overview of the potential application of low cost sensor to investigate influence of ionic strength to desalination investigation, carry out study of pH in natural water.

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