**OptoBubble – A DEVICE TO MEASURE LABORATORY BIOGAS PRODUCTION**

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<tr>
<th>PRODUCT FEATURES</th>
<th>APPROACH</th>
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<tbody>
<tr>
<td>Measures biogas production from a laboratory anaerobic digester</td>
<td>Monitoring of biogas production in anaerobic degradation process</td>
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<td>Gas produced from biological process (anaerobic process) is captured and measured in liter per day</td>
<td>To accurately measure the volume of gas produced in an anaerobic digester</td>
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<tr>
<td>Gas produced is captured and passed through a unique device (regulator) to produce uniform bubbles</td>
<td>The volume of gas produced can be used to calculate the methane yield of the degradation process using methane composition</td>
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<td>Bubbles were than counted when it passes a digital sensor</td>
<td>To produce a device that can measure biogas production optically</td>
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<thead>
<tr>
<th>NOVELTY</th>
<th>NEEDS</th>
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<tbody>
<tr>
<td>A new device that can measure biogas production from a laboratory anaerobic digester</td>
<td>There are very few devices that measure biogas production from a laboratory anaerobic digester</td>
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<td>Has the ability to measure laboratory biogas production accurately</td>
<td>There is an urgent need for an accurate measurement of biogas production from an anaerobic digester</td>
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<td>Innovative design incorporating state of art regulator and optical digital sensor</td>
<td>Conventional water-gas displacement method has its limitations such as low efficiency of accurate measurement and poor maintenance</td>
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<td>Detect bubbles and number of bubbles digitally displayed on the electronic circuit</td>
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<td>Gas regulator consists of few different diameters which regulates the gas for bubble production</td>
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<th>APPLICATIONS</th>
<th>COMPETITION</th>
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<td>Can help industry to measure biogas production accurately</td>
<td>Superior to the conventional water-gas displacement method, pressure manometers or transducers, manometer assisted syringes, or low pressure switch meters</td>
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<td>Can help in determining the ultimate methane potential of substances and their rate of biodegradation</td>
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<td>The evaluation of gas production is important because it is key indicator of any reactor performance</td>
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<td>The collection and preservation of the gas generated in the digester is the first and most important operation in gas measuring technique</td>
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BENEFITS
- Accurate measurement of biogas
- Optical bubble counter
- Simplicity and low maintenance
- Portable device
- Affordable prize

POTENTIAL MARKET
- Universities and colleges in their environmental laboratories
- Small and medium industries using anaerobic digesters
- Research institutions such as PORIM, focusing on anaerobic digesters
- Schools as demonstrating tools for students in the laboratories

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innovative ○ entrepreneurial ○ global
A CNT mixed matrix composite (CNT-M3) membrane for acid/green house gas removal has been invented through a specialized solution formation employing nanotechnology to produce membranes with superior separation capabilities.

**Product Features**
- New formulation for the fabrication of CNT polymer.
- Enhanced selectivity of 100% for CO2 separation from CH4.
- Robust and able to withstand high pressure up to 30 bar.
- Fast diffusion and smooth flow of gases through the hollow structure of CNTs.
- Novel modification technique to enhance interfacial interaction between CNTs and polymer matrix.

**Novelty**
- Carbon nanotubes mixed matrix membrane is a new category of membrane developed for enhanced gas separation properties—a new class of membrane materials.
- Ablow to combine synergistic effects and properties of the polymer with CNTs resulting in an excellent new membrane material.
- Showing more than 100% increase in selectivity for CO2/CH4 gas separation.

**Competition**
- IGCP.
- MTR.
- Nolco.
- Air liquide.

**Approach**
- A simple yet very practical approach has been designed and implemented to achieve the need statements. They are:
  - Formulation of polymer solution.
  - Development of mixed matrix membrane structure to enhance CO2 removal by controlling modification and fabrication parameters.

**Benefits**
- Structurally developed CNT-M3 achieved >100% performance improvement compared non-polyimide.
- The material developed allow membrane system to be tailored in advanced way to separate other gas impurities.
- Promote greener environment by efficiently removing CO2 gas through versatile, adaptable, environmentally friendly and easy to operate membrane technology.

**Potential Market**
The membrane gas separation membrane system market in 2010 is estimated to be about 350 million USD (RCC 2010) based on the reserves and acceptance of the technology. The relevant potential industries for membrane-based gas separation include:
- Oil and gas industries.
- Petrochemicals.
- Chemical process industries.
- Water and waste water treatment-related industries.