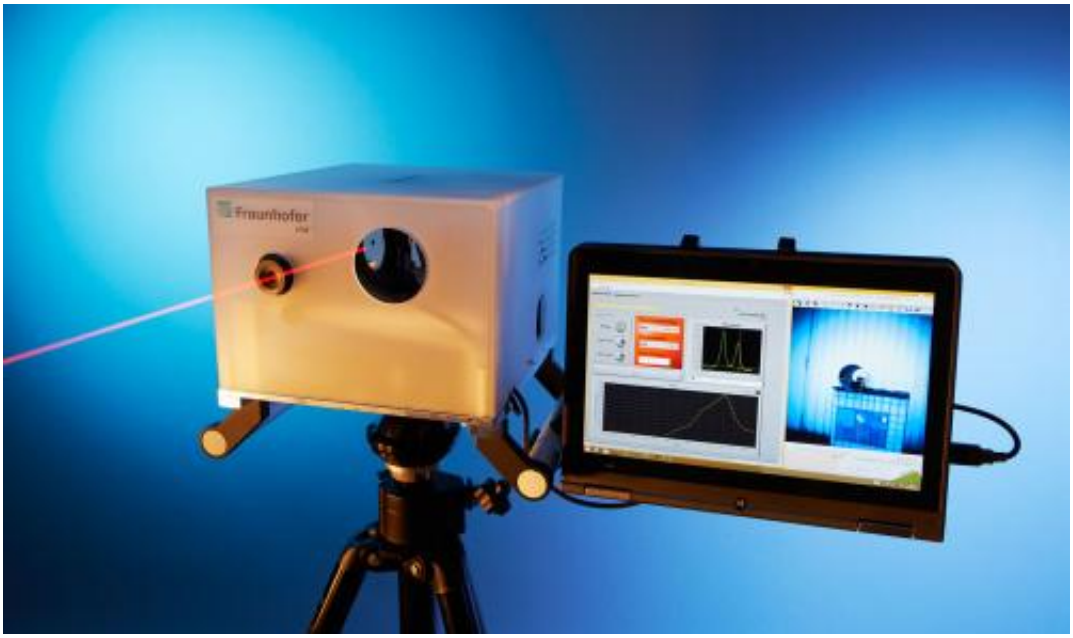
Detecting leaks in biogas plants by laser

November 4 2014



The laser-based system measures escaping biogas without contact – even from several meters away. Credit: Fraunhofer IPM

Servicing biogas plants is challenging. Leaks from which methane escapes are particularly problematic – from a security, a technical, an economic as well as an environmentally friendly perspective. Researchers are working on a technique that helps to better detect leaks. In this process, a laser discovers the leaks from several meters away.

There are nearly 8,000 biogas plants today in Germany. They use biomass-derived gas to generate electricity and heat. In 2013, the

operators produced a total of 26.42 tera-watt hours (TWh) of electricity. This represents about 17 percent of the gross electricity generation from renewable energies. In Germany, 7.5 million households are now provided with electricity in this way. The requirements for the operation and maintenance of gas plants are high. Leakage is particularly problematic. Even small leaks from the joints of the gas lines or fermenters can have consequences: Escaping methane can result in fires, economic damage and a worsening of the carbon footprint of the generated electricity.

A technology is still lacking which allows operators to track down leaks in all system parts quickly, inexpensively and safely. In a project funded by the German Federal Ministry of Food and Agriculture (BMEL), researchers and a measuring equipment manufacturer are now addressing this issue. After one and a half years, the experts have developed a demonstrator that, without making contact, detects biogas or natural gas escaping from leaks through the use of a laser. Faster and more accurate than had previously been possible. The project involved the Fraunhofer Institute for Physical Measurement Techniques IPM in Freiburg, the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT in Oberhausen and the measuring instrument manufacturer Schütz GmbH Messtechnik from Lahr.

Clearly identifying methane

The technology developed at the Fraunhofer IPM is based on optical emission and backscattering spectroscopy. In the process, the light of a strong laser beam detects escaping methane. Simultaneously, the gas irradiates part of the light back. The scientists analyze this proportion and determine the gas concentration from the absorption spectrum of the escaping substance. Since the gas spectrum is very precise, only methane is very selectively measured, and not any other gases. The technology is located in a box-shaped demonstrator. It stands on a three-legged tripod

and is directed at the part of the equipment which is to be inspected. The optical portion of the measurement system comprises the laser, detector, camera and range finder. A connected tablet PC collects the data and evaluates it. The screen displays the graphically edited information concerning the escaping methane and the exact position of the leak. Measurements from up to 15 meters of distance are possible.

Researchers can measure very precisely with the system: They have adapted the wavelength of the laser optimally. A common flange size of joints of about 15 cm is measured with three to four measurement procedures. In addition, the technology detects excessive gas concentrations in rooms and determines when these are dangerous to humans. The researchers calculate the concentration using the data from the built-in range finder. The operator also knows how much gas has already escaped. This is another unique feature of the new system.

Dr. Johannes Herbst, measurement technology expert at the Fraunhofer IPM, expects the technology to be ready for the market in the next three to five years. In the laboratory, the researchers are currently honing in on other functions. They have succeeded, for example, in detecting methane without the backscattered light. For this purpose, the gas itself is illuminated by a strong laser. "In the future, the measurement team will be able to easily check the entire system from the ground. It used to be necessary to climb ladders and identify the leaks on the spot," said Herbst.

Provided by Fraunhofer-Gesellschaft