The Biofuel Autoclave:

A low cost, non-electric solution to infectious medical waste

Health Care Without Harm (HCWH) is continuously working to improve medical waste disposal strategies in low and middle-income countries, where improper handling and disposal of medical waste contributes to the spread of disease, both in medical facilities and the surrounding communities. Without safe, sustainable, affordable, and effective methods of sterilizing medical waste, health centers must resort to dangerous methods of disposal, such as open dumping, open burning, and incineration. These approaches introduce infectious waste and hazardous pollutants into the environment, ultimately exposing the public to a multitude of health risks.

The Biofuel Autoclave during testing in Kathmandu

One of the safest methods of infectious waste treatment is autoclaving. Autoclaves use pressurized steam to disinfect medical waste and are highly effective. However, there are situations where a normal electric autoclave is not suitable- particularly rural locations and emergency situations where there are no reliable electric power sources. Unfortunately, until now a viable alternative did not exist and without one these centers are forced to burn or dump their wastes.

The Biofuel Autoclave pairs a gasketless non-electric autoclave with a highly efficient, low cost cookstove that can be powered by a variety of biofuels. This creates an autoclave that operates independent of the electric grid, lowering the primary barrier to autoclaving being a viable solution everywhere.

As part of the development effort of the Biofuel Autoclave, Wisconsin Aluminum Foundry (WAFCO), InStove and HCWH partnered with the Health Care Foundation-Nepal (HECAF) to evaluate implementation in a real-world setting. Nepal provided an ideal testing environment, as they have a developed healthcare system, but an unstable power grid and their infrastructure for medical waste disposal is lacking. HCWH and HECAF have been working together to address medical waste issues in Nepal with an ongoing implementation of safe disposal and recycling plans at hospitals throughout the country. However, thus far their strategy has relied on electric and automated autoclave technology.

While these autoclaves are ideal for urban hospitals, the Biofuel Autoclave could provide an effective solution for remote settings.

In May 2014, a joint effort between HCWH, HECAF, UC Berkeley, and InStove was employed to test the Biofuel Autoclave in Kathmandu, Nepal. Testing was performed not only to validate the autoclave but also evaluate which locally available biofuels were suitable for sterilization cycles.

Procedures for validating the efficacy of disinfection were based on challenge testing procedures developed by the GEF-supported UNDP-implemented Global Health Care Waste Project (www.gefmedwaste.org). Pressure pulsing, a technique of repeatedly building up and releasing steam pressure, was used to flush air from the waste and ensure effective disinfection.

The tests proved that the Biofuel Autoclave is versatile, as intended. It was able to reach sterilization conditions when powered by a variety of fuel sources including wood, biomass briquettes, and biogas. This flexibility of the Biofuel Autoclave makes it a sustainable solution for healthcare facilities in all parts of the world that are handicapped by lack of access to power.

The specific fuels tested were chosen based on their widespread availability at healthcare facilities. Wood is an attractive fuel source because it requires no additional infrastructure to obtain but may be problematic in areas suffering from deforestation. Briquettes and biogas have the added advantage of being made from recycled materials, making them more sustainable. Biomass briquettes can be made from recycled paper or sawdust, and are widely used in the same parts of the world that the Biofuel Autoclave is needed. Even in those places briquettes are not readily available, facilities can make their own paper briquettes on-site from waste paper. Biogas was produced by an anerobic digestion system developed at Bir hospital in Kathmandu, which uses hospital food waste to generate fuel.

Biological indicators used to test whether waste was successfully disinfected

The implications of the Biofuel Autoclave are extremely promising due to the system's flexibility and portability. It is an attractive solution to infectious waste management in rural areas and in disaster situations, when electric autoclaves may not be appropriate. The Biofuel Autoclave is an important alternate solution for further expanding the practice of safe infectious waste disposal.

A full technical report will be published in 2015. The next step is to pilot the autoclave in a rural hospital in Nepal, which is also anticipated to happen in 2015.

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