

Design Projects by 2009 Final Year Agricultural Engineering Students in the School of Bioresources Engineering at the University of KwaZulu-Natal

by

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Design Projects

Six design projects were undertaken by the 2009 final year Agricultural Engineering students in the School of Bioresources Engineering at the University of KwaZulu-Natal.

The first project, undertaken by Alaika Kassim and Samantha Moodley designed and evaluated a probe for measuring the Eh and pH of unsaturated soils. The main objective of the project was to be able to continuously measure the pH, Eh (redox) and temperature of an unsaturated soil medium and the total cost of the probe could not exceed R3000. After considering available commercial probes and alternative solutions, the project team designed a probe comprising of pH, Eh and temperature sensors located within a PVC and ceramic body with a total length of 1.0 m length and a diameter 0.025 m, as shown schematically in Figure 1. The performance of the pH meter was found to deteriorate with time as the ceramic did not create an adequate selective barrier which resulted in interactions between reference and pH electrodes and the use of a ceramic with a higher pressure was recommend for future designs. Tests of Eh measurements showed that the Eh sensor was able to adequately assess the aeration condition of the soil and the thermocouple was found to measure temperature adequately.

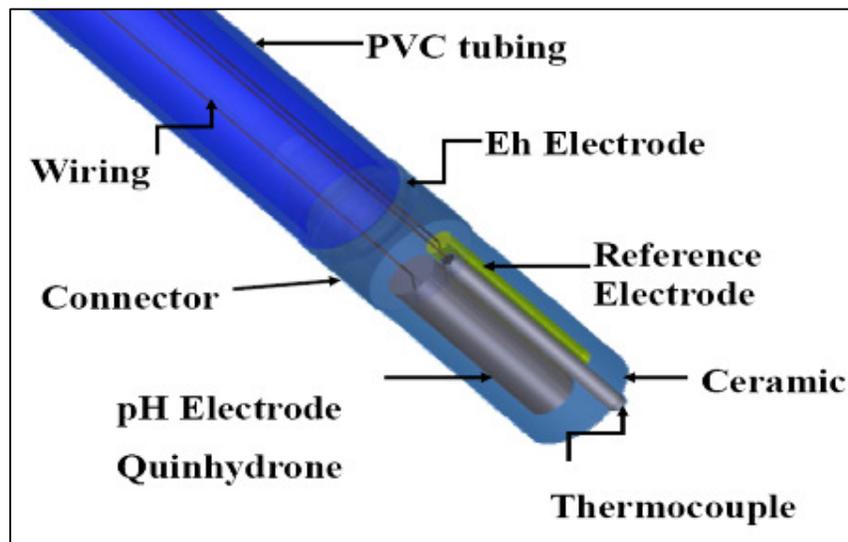


Figure 1: Schematic diagram of pH, Eh and temperature probe

Gordon Boote and Thabo Mavundza designed, constructed and evaluated an automated four way sheep sorter. The project was funded by the Institute of Agricultural Engineering at the Agricultural Research Council and formed part of a larger project to demonstrate the advantages of Radio Frequency Identification (RFID) and automatic goat and sheep handling systems. Field testing of the pneumatically operated gates controlled by a PLC was conducted as shown in Figure 2 and the theoretical sorting rate of approximately 860 sheep per hour exceeds commercially available sorters.



Figure 2: Evaluation of automatic sheep sorter

The third design project was undertaken by Nkosinathi Nsele and Nhlanhla Ngcamu who designed, constructed and evaluated drip and furrow irrigation models to aid teaching irrigation principles. The objectives were to demonstrate Bernoulli's equation, the hydraulic characteristics of drippers, dripper water distribution patterns and the impacts of slope, soil type, cut-off time and application rate of furrow irrigation. The wetting pattern of drip and furrow irrigation in sand and clay soils are evident in Figure 3 and 4 respectively.



Figure 3: Wetting pattern of drip irrigation in clay and sand soils



Figure 4: Wetting pattern of furrow irrigation in sand and clay soils

Yvonne Molepo and Gladys Lebotsa designed a sprinkler irrigation system for the Masivusane Community Garden. The design included an assessment of the available water quantity and quality, determining an optimum combination of crops and the crop water demand, conducting a topographic survey to produce a contour map, soil sampling and laboratory analyses to determine the soil texture, system layout, hydraulic design, scheduling plan and economic analyses. Once the design was completed, the performance of a similar irrigation system was determined. Some activities performed by the students are shown in Figure 5.



Figure 5: Activities undertaken as part of the field irrigation design

Albert Motloung and Mahlatse Mamabolo designed, constructed and evaluated a biogas digester unit which utilises a hydraulic pressure balancing valve to promote mixing within two chambers using the pressure of the biogas within the chambers to mix the slurry and thus speed up bacterial growth. A schematic diagram and the constructed unit are shown in Figure 6. Laboratory analysis of the hydraulic valve, inset in Figure 6, was found to perform satisfactory. Slow bacterial growth and biogas production prevented the unit from being fully evaluated.

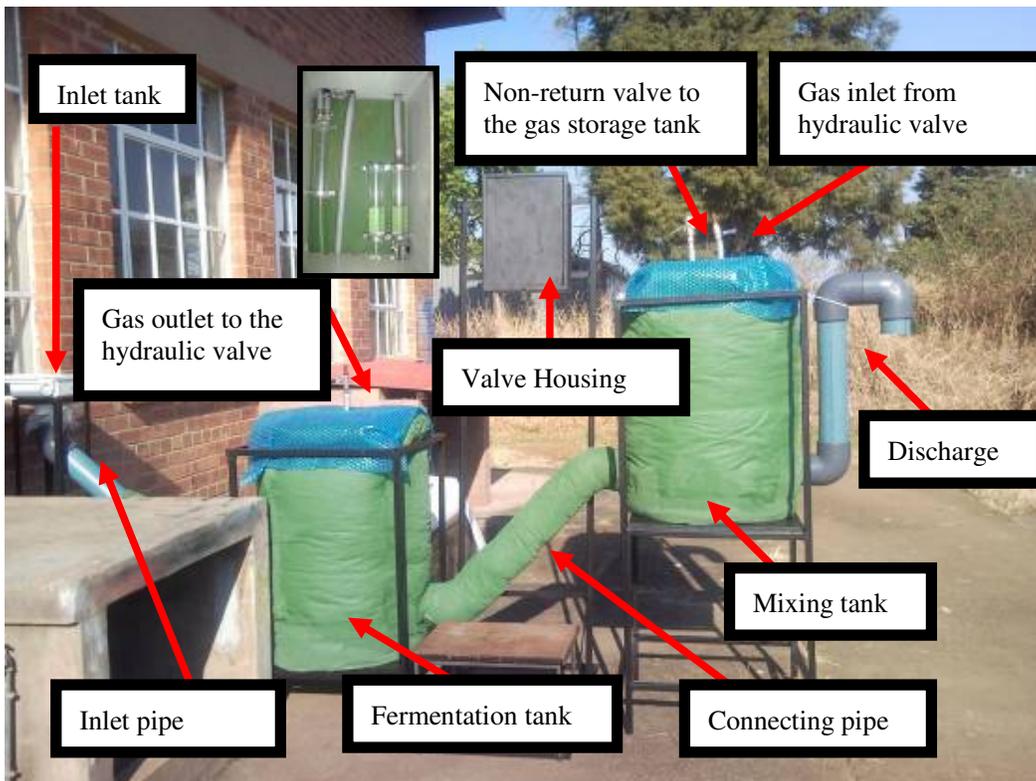
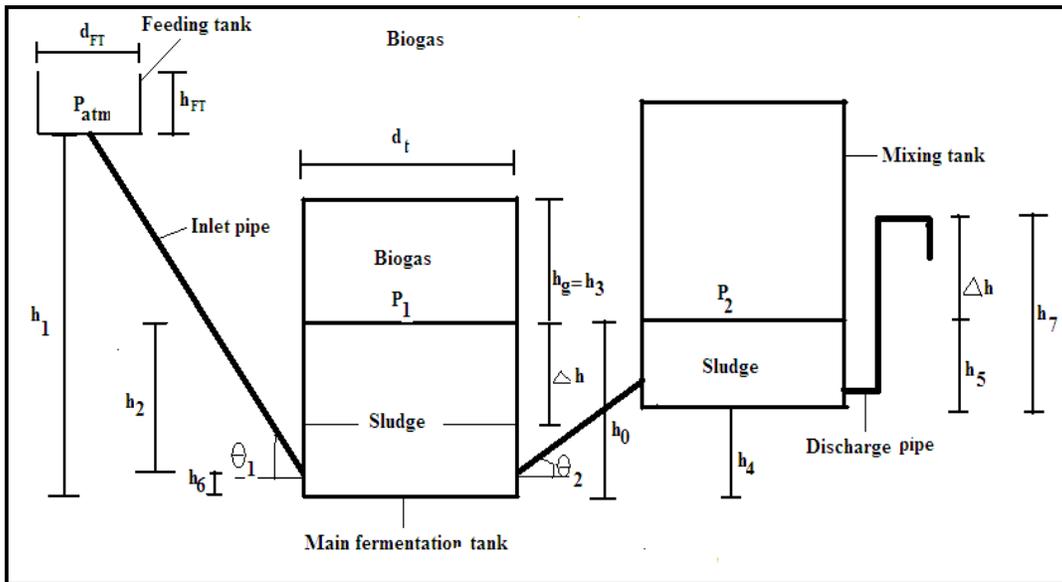


Figure 6: Schematic diagram and constructed digester and hydraulic valve (inset).

Dumisani Sibuyi designed, constructed and evaluated a selective herbicide applicator, as shown in Figure 7, where the client wanted the rope wicks to selectively apply herbicide to taller vegetation ranging in height from 150 to 500 mm. Initial testing of the applicator indicated that it effectively applied herbicide to taller vegetation.



Figure 7: Selective herbicide applicator

Awards

The SAIAE Council provides incentive and recognition awards for students who perform well academically. The following awards were made to Agricultural Engineering students at UKZN for excellent academic performance in 2008:

- First Year: Tshifhiwa Ramakapola
- Second Year: Setsembile Dlamini
- Third Year: Gordon Boote
- The SAIAE Bronze medal award for the best graduate in 2008: Thandeka Meyiwa



Figure 8: Thandeka Meyiwa receives the best graduate award in 2008 from Prof Jeff Smithers (President of SAIAE)

The automated four way sheep sorter projected project was selected by the examiners as the best final year design project for 2009 and Gordon Boote and Thabo Mavunza received both the MBB Consulting Engineers Prize and the SAIAE Floating Shield for the best design project (Figure 9).



Figure 9: Mr Alick Rennie (MBB Consulting Engineers), Gordon Boote and Thabo Mavunza (best final year design project) and Prof Jeff Smithers (SAIAE President)

Samantha Moodley was awarded the best workshop practice prize sponsored by Gedore Tools (SA) and Mr Alan Hill made the award to Samantha on behalf of the sponsor (Figure 10).



Figure 10: Samantha Moodley receives the Gedore Tools best work practice award from Mr Alan Hill

Acknowledgements

The following financial and other contributions made to the design projects are gratefully acknowledged:

- Institute of Agricultural Engineering, Agricultural Research Council – Prof Timothy Simelanga
- Grassland Science at UKZN - Prof Kevin Kirkman
- RG Burton Controls – Mr Ricky Dayanand
- Dr Colin Southway and Mr M Somaru – Chemistry at UKZN
- Mr V Dorasamy - Soil Science at UKZN
- Troy Manufacturing
- Dr George Tivchev
- Mr Francois Cilliers

Mr Richard Robertson from MBB Consulting Engineers and the SAIAE are thanked for making available awards for the best design project. Mr Herman Schmitz from Gedore Tools (SA) is also thanked for providing a prize to the student with the best workshop practice. The food and drink at the KZN-SAIAE branch meeting, where the students presented their projects, was sponsored by LRI (Mr James Brodie) and LIMA (Mr Duncan Stewart), who are both thanked for this generous contribution.