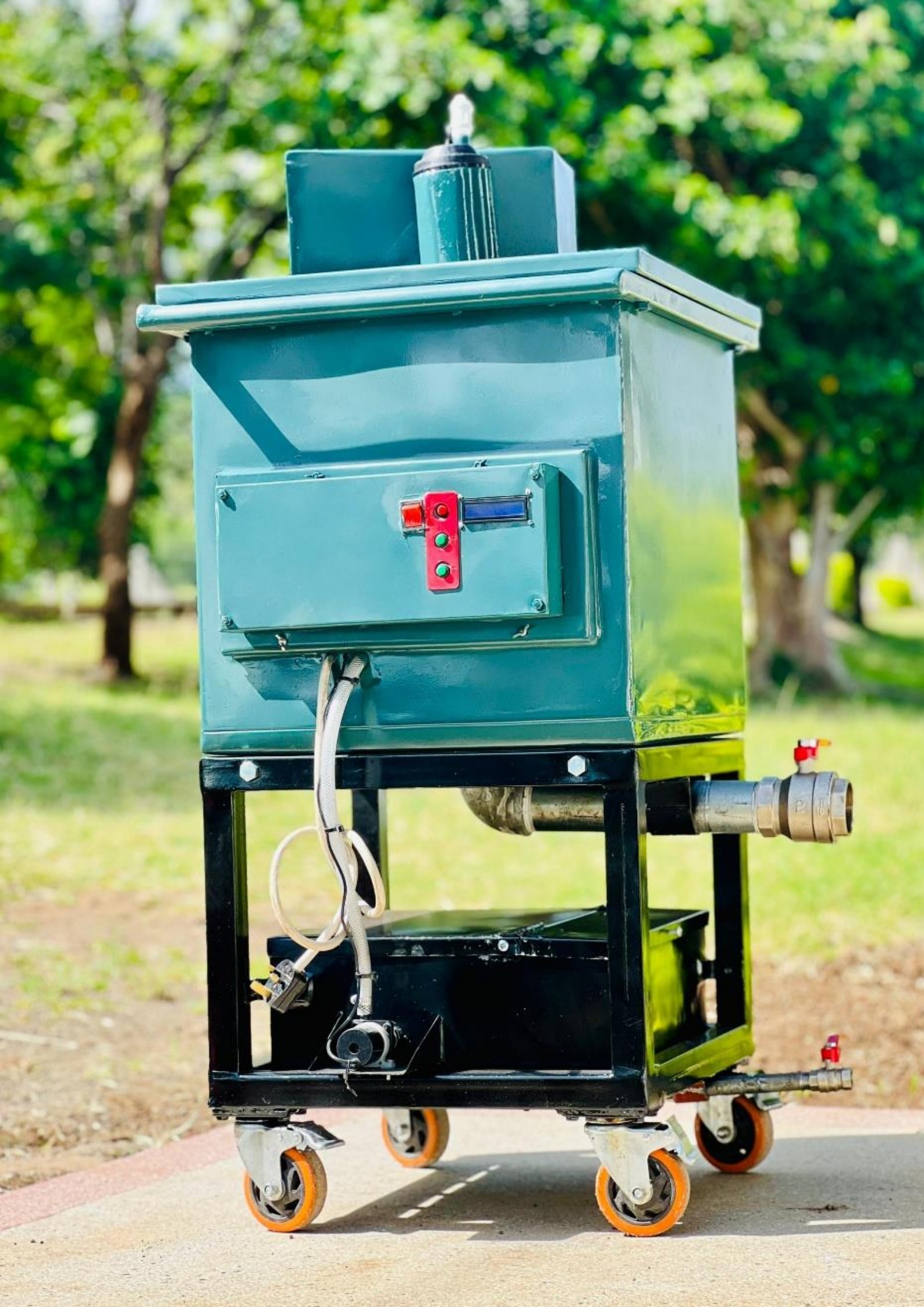

OPERATION AND MAINTENANCE OF THE ENHANCED DUO REACTOR (EDR)

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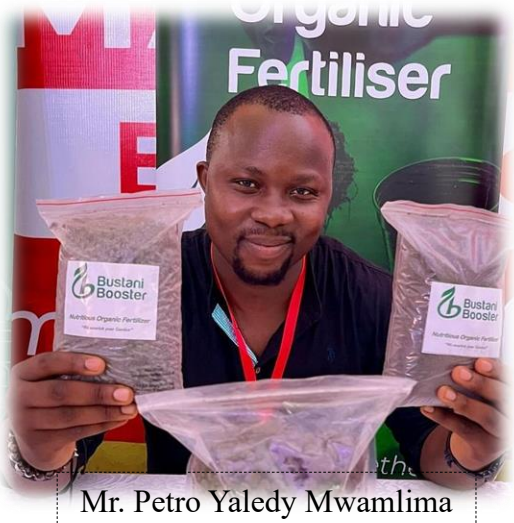
Preface

An Enhanced Duo Reactor (EDR) is a sophisticated machine for the co-production of biogas and organic fertilizer (also referred to as compost) under a controlled environment of temperature, moisture content, feedstock mixing and decomposing organisms. The machine was invented by three academicians in Tanzania, a PhD student, a full professor and a senior lecturer at the Nelson Mandela African Institution of Science and Technology (NM-AIST) called Mr. Petro Yaledy Mwamlima, Prof. Karoli N. Njau and Dr. Mwemezi Rwiza, respectively. The machine was invented to initially serve as a laboratory facility aiding smooth, accurate and reliable studies on biogas and compost production in technical schools, colleges and universities, in a global context. It is fully automated with a sensor-aided system that regulates temperature, moisture and mixing/turning patterns. Moreover, no intensive monitoring is needed and it can always be operated remotely provided that both the machine and the operator are connected to the Internet.



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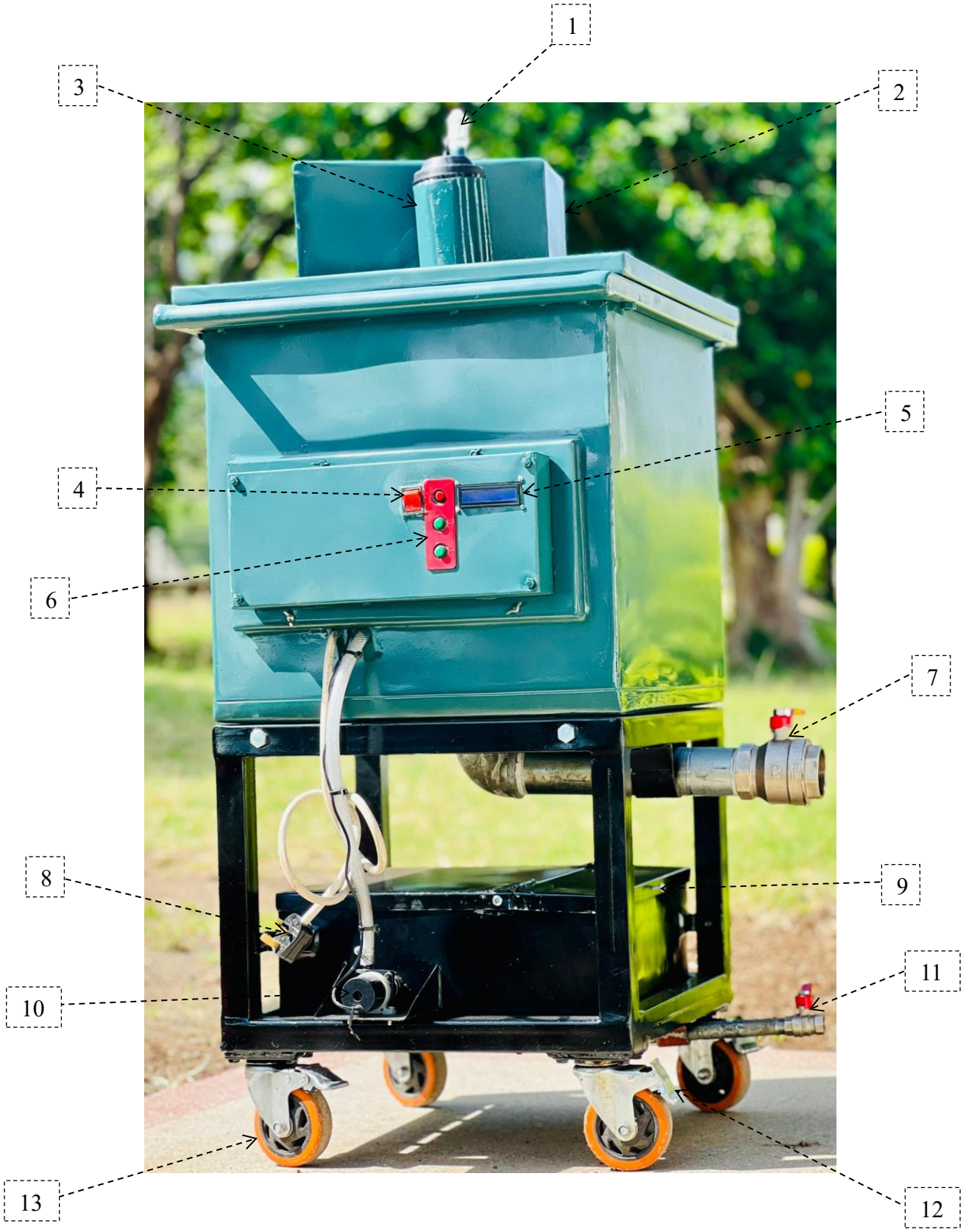
Machine parts



Key;

Part Number	Meaning
1	Biogas vent pipe
2	DC Motor casing
3	Inlet/Feeding pipe
4	Electric Switch
5	LED Display
6	Parameter set/controller panel
7	Compost Ejection Pipe
8	DC power cable
9	Surplus water reservoir
10	DC water pump
11	Water ejection pipe
12	Caster peddle locks
13	Caster Wheels

Operation Procedures

[1] Machine inspection

Before starting the operation of the EDR machine the operator must make sure to conduct a thorough inspection. The inspection is done by observing the condition of the machine, if any dirtiness is observed inside or outside the machine, must be cleaned. This is done to ensure that no contamination might impair the quality of the experimental results. Furthermore, the operator must connect the DC power cable (machine part 8) and switch on the machine to check if it operates as intended. More importantly, make sure all stoppers including the ball valves, overflow pipe stopper, feeding stopper, and biogas vent pipe stopper are closed. Place the machine where it is supposed to stand while operating then lock the wheels of the caster wheels (machine parts 12 & 13) so that it doesn't move.

[2] Loading of the feedstock

The feedstock under analysis for either producing organic fertilizer (compost) or biogas must be shredded if in solid form and thereafter mixed with water in a desired ratio prescribed by the researcher/operator then powered in the reactor via the inlet/feeding pipe (machine part 3). If the feedstock is in liquid or slurry form there must be no need for shredding unless the research has an objective of evaluating the influence of particle size on the process. Since the inlet/feed pipe has a stopper, the operator must make sure to remove the stopper first load the feedstock in the reactor and then fit back the stopper. The stopper is fitted back to ensure that the system operates in a completely anoxic state as intended.

[3] Setting the operating parameters

After the machine has been inspected, the operator must switch it on by pressing the switch (machine part 4), then temperature, moisture content and turning/mixing frequency and intervals are set using the control buttons at the parameter set (machine part 6). The parameters being set are displayed by the LED display (machine part 5) which is adjacent to the parameter set or controller panel. The navigation buttons having the positive (+) and negative (-) are used to add or reduce the set values, moreover inured to move to the next set value the operator presses the set button. After finishing the last value, the machine will display information showing you that it is ready to start its operations. In case you want to reset it at any time, you just have to press the set button (red button at the control panel). The machine will operate as required, even when the power goes off, it will resume where it stopped so need to reset it after the power cut.

[4] Biogas collection

The biogas is collected by the biogas vent pipe (Machine part 1) located at the top of the machine, initially, the pipe has a stopper to prevent gas from escaping but depending on the researcher's intention/goal, the gas can always be collected by connecting a flexible extension biogas pipe to the biogas bag. Biogas can easily be analyzed and scrabbed if required by the researcher, the analysis can well be done at the biogas vent pipe, while scrabbing provisions can be made just before the gas enters the biogas bag.

[5] Compost collection

The organic fertilizer/compost is collected using the Compost Ejection Pipe (machine part 7), the opening and closing of the compost ejection is done by moving the ball valve lock clockwise and ant-clockwise. The compost is collected by either a bucket or any collecting facility desired by the operator/researcher.

[6] Reject water collection

The surplus water remaining in the surplus water reservoir (machine part 9) after the operation is done is ejected by the water ejection pipe (machine part 11). The remaining surplus water shall only be removed when the whole compost/biogas production process is done, and no otherwise.

[7] After operation provisions

After the operation of the machine is done, the operator or researcher should make sure to switch it off, clean it outside, then switch it on and clean it inside the reactor. Set the machine to switch on the mixing rod so and pour water at the inlet pipe and sire it to remove all wastes, the water inside the reactor is removed by opening the compost ejection pipe. Clean until you see clean water coming out.

Maintenance Procedures

Although major machine faults that have potential of stopping the machines operations are not expected, yet the operational errors might lead to machines multifunctioning that may impaired the quality and reliability of results/data obtained. In any case if a fault is detected by the operator/researcher, he/she should examine the source of fault immediately. The operator should identify if the fault is electrical based or mechanical based, in anyhow, the machine operation should be stopped and an expert be contacted to resolve the fault, unless if the operator is knowledgeable or has been trained and certified as the operator and maintainer of the machine.

For electrical fault, the person doing maintenance either being the mechanic or electrician should be able to read, interpret the circuit board and fix the issue at the control unit of the machine. Furthermore, for mechanical fault the machine is dismantlable, its can be dissembled and assembled back, so following the drawings offered by the manufacturer, the mechanics should be able to trace the fault and fix it.