

TRILLION GASIFIER

Operational

And

Maintenance Manual

(For Model TG 180 Only)

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1. INTRODUCTION

Thank you and congratulation for making the important decision to purchase our Trillion Gasifier. Your decision will not only go a long way to save you on your diesel running cost, but most importantly is your commitment to do your part to save our planet. Our Trillion Gasifier model TG 180 is especially designed to be tar-free and easy to operate. It is suitable for use in diesel engine power generation especially in remote area that are far away from the grid line, for running of diesel engine driven water pump and in any other application where diesel engine operates on a regular basis etc. Our design is based on our detailed research and study on the principle of tar formation from the combustion process of rice husk and other biomass waste, and the detailed analysis of the physical and chemical properties of tar compound. With this important information on hand, we spend the next phase of our development to design our state-of-the-art Trillion gasifier that has the full capability to control the formation of tar to the minimum during the combustion process. Our specially designed filtration system can thoroughly and efficiently cleaned up the gas to give a standard gas quality that is fully in compliance with the FAO specifications, therefore suitable for any engine operation.

1.1 Quality of Trillion Gasifier's Producer Gas

- *Dust* <5mg/m³ gas
- *Tar* <500mg/m³ gas
- *Acid* < 50mg/m³ gas
- *Temperature at engine intake* Ambient temperature (up to approx. 30 to 35°C)

1.2 Advantages of the Trillion Gasifier

- *Reduce diesel fuel consumption by 50% to 85% at rated load*
- *Low capital investment i.e. fast payback*
- *Easy to install and simple to operate*
- *Compact design*
- *Low maintenance cost*
- *Low biomass consumption*
- *No unpleasant smell*
- *No engine modification required*
- *No deration on the engine output*
- *Will not affect the engine life span*
- *Improved existing engine performance*
- *Availability of carbon credit for sale*

2. KEY COMPONENTS AND FUNCTIONS

Reactor

For generating producer gas by means of combusting the biomass.

Tar Separator

For separating the tar from the producer gas which are then discharged through the water seal.

Gas Cooler

To remove water content and for cooling the producer gas to ambient temperature.

Tar Filters

For removing any minute traces of tar or tar vapour from the producer gas.

Safety Filter

As an added safety protection to prevent tar from passing through the system after tars are sighted in the safety sight tube.

Gas Filter

For removing any fine particles that may be carried over with the producer gas.

Safety Sight Tube

To enable early detection of tar in the gas.

KEY COMPONENTS ON TRILLION GASIFIER MODEL TG 180



Fig 1. Front View TG 180

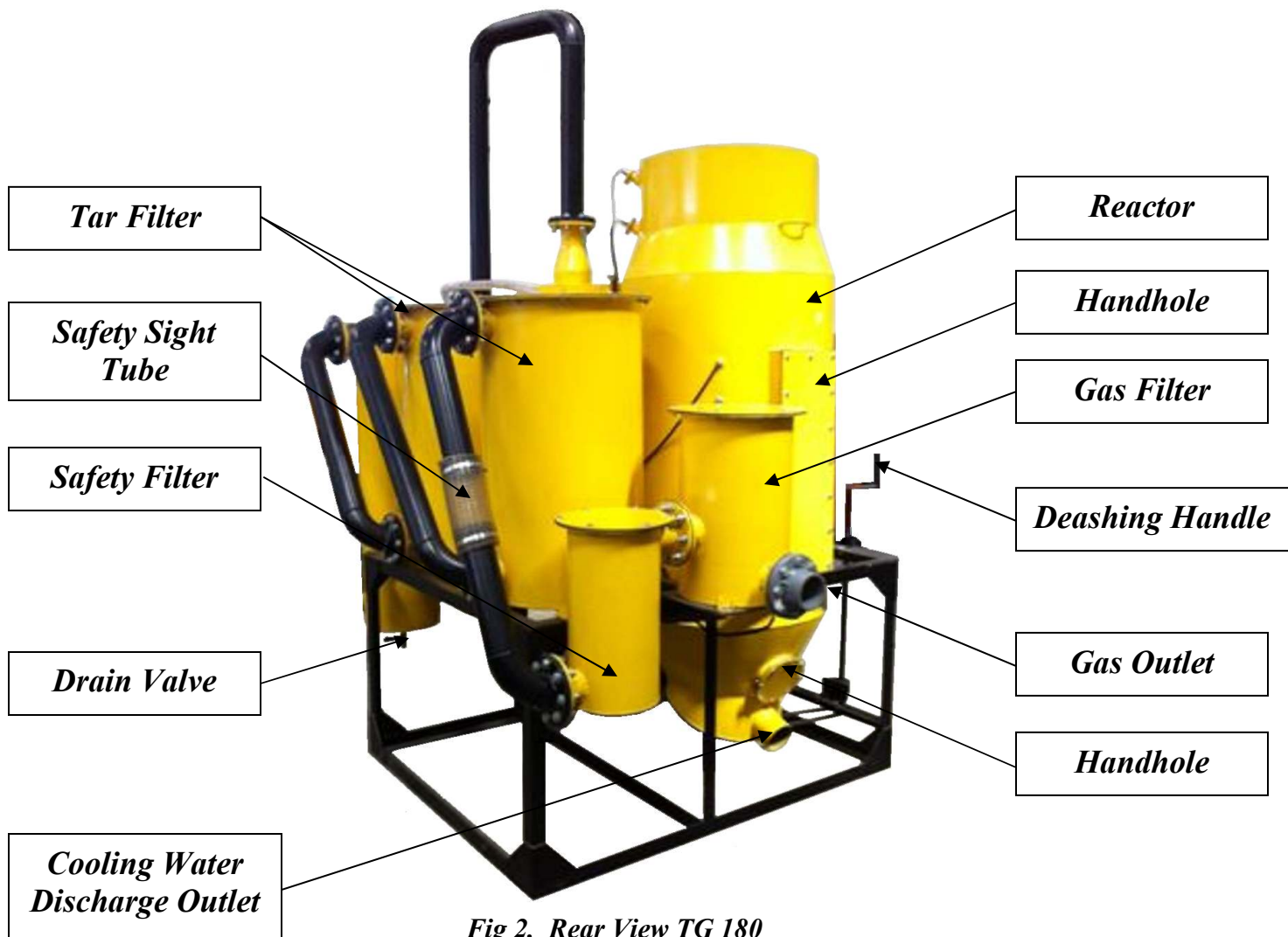


Fig 2. Rear View TG 180



Fig 3. Standard Control Panel (Left) & With Auto Charging & Discharging (Right)

3. HOW TO SET UP THE GASIFIER WITH THE ENGINE

(1) Install the gas and air control valve train as shown in the following pictures. The recommended type of valve to be used are:

- a. Brass ball valve for the gas control valve
- b. Brass gate valve for the air control valve.

(Note: Brass gate valve is strongly recommended for the air control valve to ensure accuracy in the calibration of the air-gas ratio.)

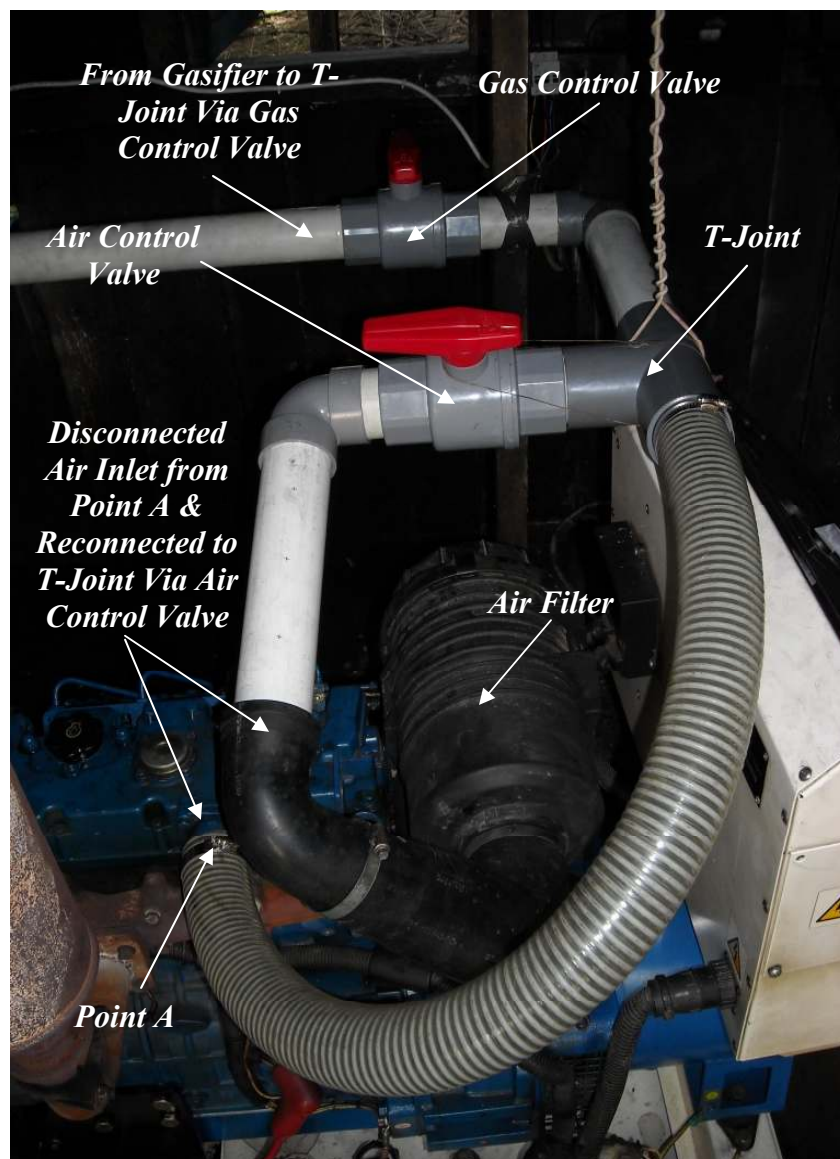


Fig 4. Example 1 Air & Gas Valve Connection

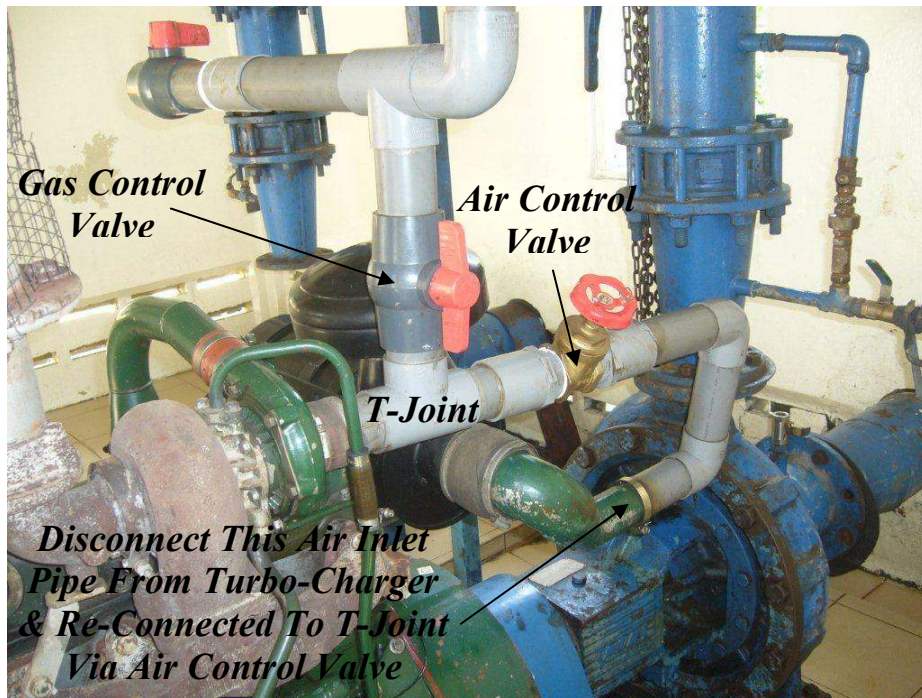


Fig 5. Example 2 Air & Gas Valve Connection

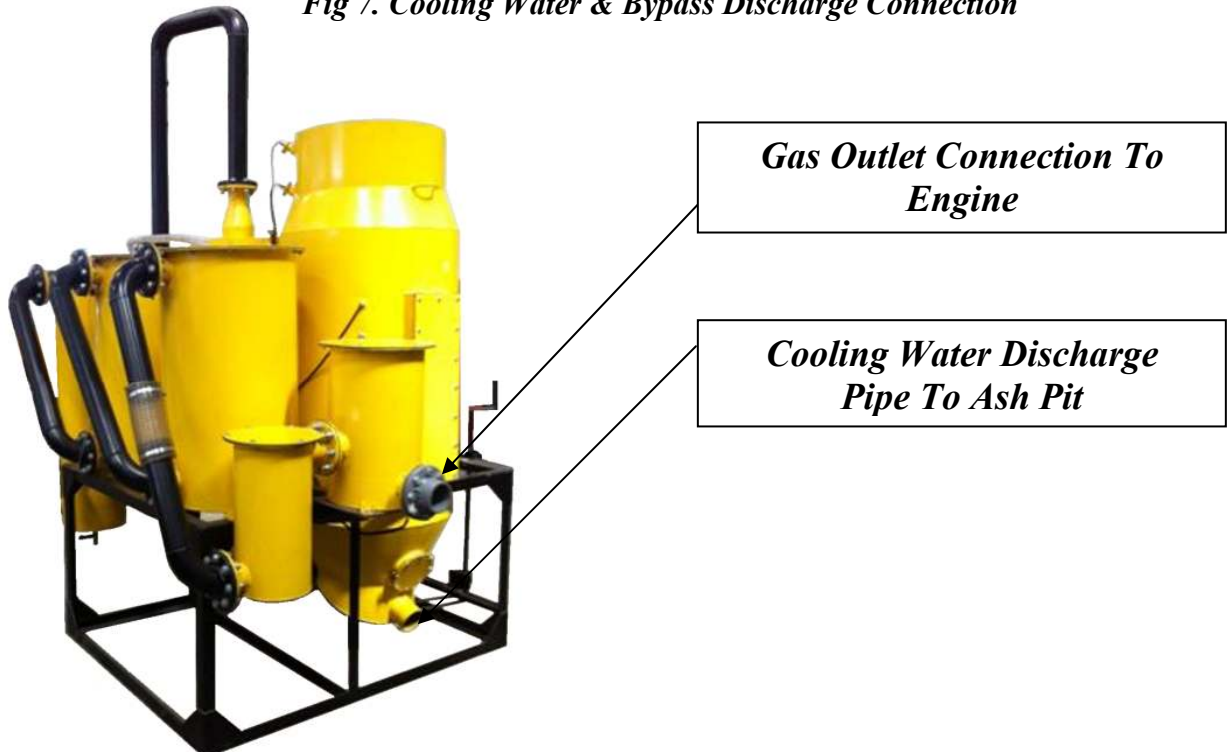


Fig 6. Example 3 Air & Gas Valve Connection

- (2) *Connect the gas outlet from the TG 180 gas filter to the gas control valve using PVC pipe.*
- (3) *Connect the water pipe/hose as shown below.*

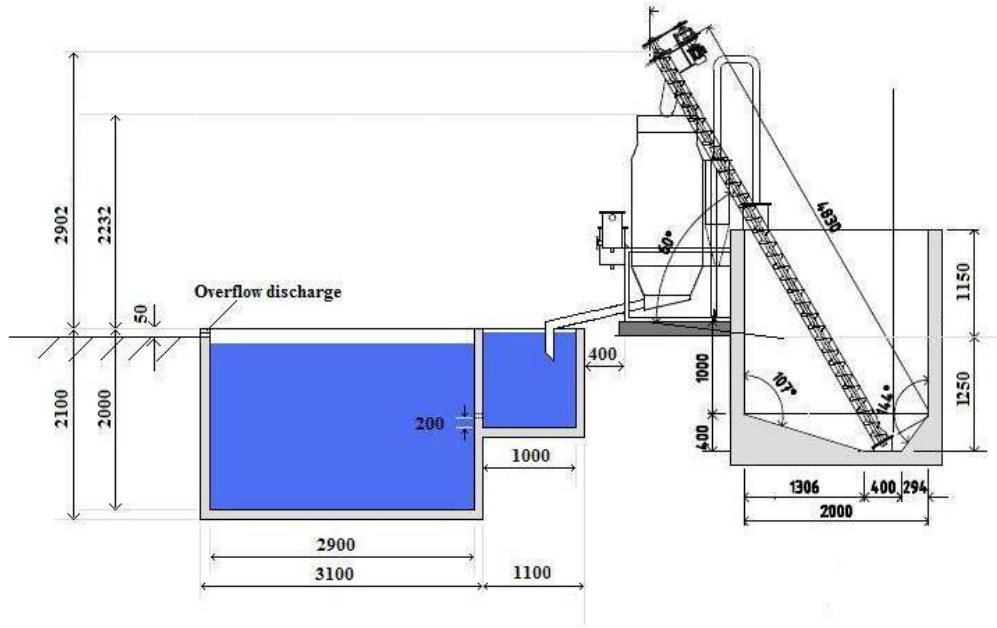


Fig 7. Cooling Water & Bypass Discharge Connection



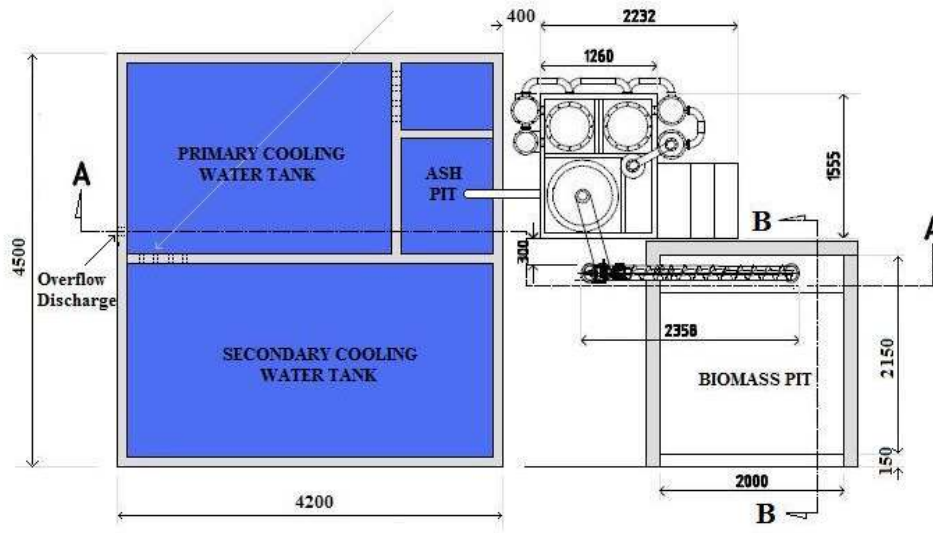
(4) Position the reactor discharge pipe over the ash pit as shown in the drawing and picture below. Please refer to recommended cooling water re-circulating tank and ash pit drawings for detail layout and dimension.

(Note: Drawing shown is with optional auto charging system)



SIDE VIEW SECTION A-A

4 HOLES DIAMETER 50 MM TO BE LOCATED 300 MM FROM THE BOTTOM OF THE TANK



PLAN VIEW

4. PRECAUTION TO TAKE WHEN MOUNTING THE GASIFIER

- (1) When mounting the gasifier, please ensure that the gasifier is leveled to the ground by using a water level gauge.*
- (2) Open the hand hole on the reactor to check that the gasifier stones are position snugly together. **Please ensure that there must be no space or gaps between the gasifier stones.***
- (3) Check all the interior of the piping to ensure that they are thoroughly clean of dirt and dust.*

5. CHECKLIST PRIOR TO GASIFIER STARTUP

- (1) Check and ensure all the drain valves or plugs are shut / close.*
- (2) Check and ensure that there is sufficient level of water in the ash pit and the tar separator water trap can so as to provide a proper water seal.*
- (3) Ensure that a proper strainer is fixed to the foot valve or water inlet pipe of the pump so as to prevent ingress of particles in the water from clogging the water spray pipe nozzles inside the reactor.*

6. STARTUP PROCEDURE

- (1) Fill up the reactor with about 10 cm (4 inches) of biomass.*
- (2) Open up both the air and gas control valves.*
- (3) Start the engine on diesel mode.*
- (4) Start the water pump and keep the by-pass valve fully open.*
- (5) Close the air control valve.*
- (6) Light up some waste paper and drop it into the reactor. Spread the burning paper evenly over the biomass and allow the biomass to burn.*
- (7).When the biomass catches fire, spread the ember evenly and then top up the reactor with another 10 to 15 cm (4 to 6 inches) of biomass.*
- (8)You will now notice some changes in the engine sound. Gradually open up the air control valve until the engine sound returns to normal. The air and gas ratio is now calibrated.*
- (9) Top up the biomass to the top of the reactor.*
- (10) Check the water temperature gauge and slowly close the bypass to stabilise the cooling water outlet discharge temperature at 40 degree C.*
- (11) Check the gas outlet temperature to ensure that it is below 30 to 35 degree C.*

7. METHOD TO ESTIMATE THE DE-ASHING INTERVAL

- (1) Repeat step 6.(1) to 6.(8).*
- (2) Top up the biomass to the upper sight glass position inside the reactor.*
- (3) Next, check for the glowing ember of the burning biomass to appear at the lower sight glass. Continue to monitor until this glowing ember disappeared from the lower sight glass. Immediately start a stop watch to measure the time taken for the biomass to burn from this position till the burning biomass appears at the surface of the biomass at the upper sight glass position. (During this test, replenish at regular interval to maintain the biomass inside the reactor at the upper sight glass level).*
- (4) The total time taken will be the estimated time between de-ashing.*

Note: The de-ashing interval will varies depending on the type and moisture content in the biomass

8. DE-ASHING PROCEDURE

- (1) Look through the upper sight glass and des-ash when you see the glowing ember of burning biomass.
- (2) Turn the de-ashing handle to de-ash until you see the glowing ember of burning biomass appearing from the lower sight glass.
- (3) Fully replenish the reactor with biomass.

9. PRECAUTION TO TAKE WHEN OPERATING THE GASIFIER

- (1) Check regularly and ensure that at all time, there is a constant supply of water to the system and that the water discharge temperature is constantly maintain at about 40 degree C. The water supply is extremely important for the effective functioning of the gasifier. **Do not operate the gasifier without cooling water at any time.**
- (2) Check and ensure that the gas temperature is below 30 to 35 degree C.
- (3) “De-ash” and replenish the biomass at regular interval.
- (4) Check and ensure that the safety sight tube is free of tar at all times. **Do not operate the gasifier once tar is detected in the safety sight tube.**

10. CHECKLIST FOR GASIFIER SHUTDOWN

- (1) Open the drain valve / plug of the gas cooler, tar filter, safety filter and gas filter.

Note: (a) From the gas cooler, you will get water.

(b) From tar filter, you will get a dark or brown color water with tar.

(c) From the safety & gas filter, you will only get a small amount or no water. If there are some traces of tar present, check and replace the tar & safety filter bag & gas filter.

- (2) Remove all the left over biomass in the reactor and proceed to clean and clear the holes on the ash grate.
- (3) Clear the ash and char in the ash pit.

11. MAINTENANCE SCHEDULE

- (1) Every 200 to 250 hours

(a) Remove the primary tar filter and replaced it with the existing tar filter bag from the secondary tar filter. Next replace the secondary tar filter with a new tar filter bags.

- (2) Every 250 hours

(a) Disassemble the tar separator to check and clean the reactor outlet chute.

(b) Open the hand hole on the reactor and check for accumulation of ashes between the gasifier stones. If there is excessive accumulation of ash between the gasifier stones, clean and wash with the aid of a pressurized water gun

(c) Check and clear the water nozzles in the reactor if it is choked.

(d) Check the holes on the ash grate in the reactor and if necessary, restore the holes to the original size.

(e) Check the cooler for any blockages

(f) Check the gas filter and clean up if necessary.

(g) Check and clean all the gas pipes.

(3) Every 1000 hours

(a) Replace the safety and gas filter.

(4) Every 2000 hours

(a) Clean the gasifier stones with wire brush or hot water, or with the aid of a pressurized water gun.

If the filter bags for both tar & safety filters and/or gas filter are found to be extremely wet, replace the filter bag immediately. A wet filter bag will not be able to perform to its maximum efficiency.

12. ENGINE SELECTION GUIDE FOR GASIFIER

(1). Use only direct injection engine system.

(2). Use only engine capacity up to 180 hp with cylinder displacement below 14000cc.

(3). If possible, avoid short stroke engine.

13. IMPORTANT SPECIFICATIONS THAT YOU NEED TO KNOW

(1). Water Pump Capacity (minimum) : 120 Litres/min

(2). Minimum Cooling Water Capacity : 28.0 m³

(3). Recommended ash pit external dimension : 2m X 1m X 1m (L X W X D)

(4). Moisture Content of Biomass : < 15%

(5). Ideal Size of Bio-mass : <12mm X 12mm X 12mm

(6). Air porosity of bio-mass must be good

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TROUBLE SHOOTING GUIDE

NO	PROBLEMS	POSSIBLE CAUSES	SOLUTION
1.	<i>Engine Instability.</i>	<i>Incorrect air-gas ratio.</i>	<i>Adjust air and gas control valves.</i>
2.	<i>Engine does not stop even though air control valve is completely closed. (for testing of air leakage in the system).</i>	<i>Opening of filter drain valves or plugs or air leakage in the piping.</i> <i>Water seal does not exist at the base of the reactor or tar separator.</i>	<i>Close the drain valves or plugs. Check and seal air leakage in the piping.</i> <i>Add water to the ash pit and tar separator water trap can to create the water seal.</i>
3.	<i>Exhaust misfiring.</i>	<i>Excessive gas-air ratio.</i>	<i>Open the air control valve slowly until the misfiring ceased.</i>
4.	<i>Excessive fuel consumption.</i>	<i>Blockage on the tars filter and/or gas filter.</i> <i>Engine overloaded.</i> <i>Engine due for overhauling service.</i> <i>Mis-operation</i> <i>Incorrect injection timing.</i> <i>Too lean gas-air ratio.</i> <i>Insufficient compression.</i> <i>Air leakages in the piping</i>	<i>Replace with genuine filter.</i> <i>Check engine load.</i> <i>Service the engine.</i> <i>Train the operator.</i> <i>Check injection timing.</i> <i>Slowly adjust to reduce the opening of air control valve.</i> <i>Check engine compression.</i> <i>Check and seal air leakage in the piping.</i>
5.	<i>“Water pumping” in the tar separator trap can.</i>	<i>Holes on the ash grate and / or reactor outlet square chute are clogged with ash.</i>	<i>Clean and clear the holes on the ash grate and chute.</i> <i>Check for gaps between the gasifier stones and fill up the</i>

NO	PROBLEMS	POSSIBLE CAUSES	SOLUTION
			<i>gaps with the appropriate size of gasifier stones.</i>
6.	<i>“Overflow” of water from tar separator.</i>	<i>Excessive water to reactor.</i>	<i>Increase the opening of the bypass line to redirect away the excess water.</i>
7.	<i>Uneconomical fuel consumption when engine load are increased.</i>	<i>Engine overload.</i> <i>Incorrect governor action.</i>	<i>Reduce engine load.</i> <i>Check engine governor.</i>
8.	<i>Engine not accepting gas input.</i>	<i>Engine running at full or over load with excessive load variation.</i>	<i>Reduce engine load.</i>
9.	<i>Traces of tar at the safety sight tube or engine inlet.</i>	<i>Improper installation of the tar filter bag.</i> <i>Wrong type of filter used.</i> <i>Filter bag is saturated</i>	<i>Re-installed the filter bag and ensure that it fits snugly in the filter.</i> <i>Use genuine tar filter bag.</i> <i>Replace filter bag</i>
10.	<i>The air control valve opening needs to be reduced day by day to achieve optimum engine operation.</i>	<i>Possibility of clogging of the filter or gas pipe.</i>	<i>Perform gasifier maintenance.</i>
11.	<i>Reactor over-heats and burn paint work.</i>	<i>Insufficient water supply.</i>	<i>Check for water leakage on water pump or along the water pipe line.</i> <i>Check water pump.</i> <i>Insufficient water supply.</i>
12.	<i>Excessive traces of water in the gas filter.</i>	<i>Overheating in the reactor, causing excessive “carry-over” of water vapour.</i>	<i>Insufficient supply of water. (change tar and gas filter if it is excessively wet)</i>
13.	<i>Excessive deposit of tar in the gas filter</i>	<i>Using non recommended Biomass or tar filter.</i>	<i>Use only recommended biomass as stated on the nameplate.</i>

<i>NO</i>	<i>PROBLEMS</i>	<i>POSSIBLE CAUSES</i>	<i>SOLUTION</i>
	<i>Tar presence in sight glass</i>	<i>Using non recommended/wrong tar filter.</i>	<i>Use genuine tar filter bag</i>
		<i>Improper installation of filter bag.</i>	<i>Re-installed the filter bag and ensure that it fits snugly in the filter.</i>
		<i>Filter bag is wet or saturated with tar.</i>	<i>Replace filter bag.</i>
		<i>High moisture content in the biomass.</i>	<i>Use dry biomass.</i>
<i>14.</i>	<i>Some “bubbling” noise from engine exhaust.</i>	<i>High water vapour content in the gas mixture.</i>	<i>Ensure that the reactor is not overheating.</i>
		<i>Tar and/or gas filters are wet.</i>	<i>Replace filter bags.</i>
		<i>Overheating in the heat exchanger (cooling water too hot).</i>	<i>Use cold water or replace the re-circulating water in the gasifier system. Ensure cooling water tank capacity is correct.</i>

OPERATION WITH AUTO CHARGING AND DISCHARGING SYSTEM**1. STARTUP PROCEDURE**

- (a) Repeat step 6.(1) to 6 (8).
- (b) Put the auto charging and discharging switch to auto.
- (c) Repeat step 6.(10) to 6.(11)

2. PRECAUTION TO TAKE WHEN OPERATING IN AUTO MODE

- (a) Check regularly and ensure that at all time, there is a constant supply of water to the system and that the water discharge temperature is constantly maintain at about 40 degree C. The water supply is extremely important for the effective functioning of the gasifier. Do not operate the gasifier without cooling water at any time.
- (b) Check and ensure that the gas temperature is below 30 to 35 degree C.
- (c) Check and ensure that the reactor is full or almost full.
- (d) Drain the cooler and tar filter drain valves at least once every 4 hours.
- (e) Check and ensure that the safety sight tube is free of tar at all times. Do not operate the gasifier once tar is detected in the safety sight tube.

3. PROCEDURE FOR GASIFIER SHUTDOWN

- (a) Open the air valve and then shut off the gas valve.
- (b) Put both the charging and discharging switches to manual.
- (c) Manually start the deashing motor to clear the reactor. Stop the deashing motor when the reactor are cleared.
- (d) Proceed to clean and clear the holes on the ash grate.
- (e) Open the drain valve / plug of the gas cooler, tar filter, and gas filter.

Note: (i) From the gas cooler, you will get water.

(ii) From tar filter, you will get a dark or brown color water with tar.

(iii) From the gas filter, you will only get only a small amount or no water. If there are some traces of tar present, check and replace the tar filter bag & gas filter.

- (f) Clear the ash and char in the ash pit.

4. SETTING FOR REACTOR TEMPERATURE CONTROLLER

(a) Reactor Temp 1 (RT 1) : _____ °C

(b) Setting for over deashing : _____ °C

(a) Reactor Temp 2 (RT 2) : _____ °C

(b) Setting for under deashing : _____ °C

Factory Setting For Inverter

SETTING PARAMETER INVERTER WJ200

func code	name	setting
F002	acceleration time	5sec
F003	deceleration time	5sec
A001	frequency source	01
A002	run command source	01
B012	level of electronic thermal	6,8
B022	overload restriction level	10,2
C026	alarm relay function	03
C036	alarm relay active state	00
C041	overload warning level	7,82

SETTING PARAMETER INVERTER X200

func code	name	setting
F002	acceleration time	3sec
F003	deceleration time	3sec
A001	keypad potentiometer	00
A002	run command source	01
A003	base frequency setting	50
A004	maximum frequency setting	60
B003	retry wait time before motor restart	3sec
B012	level of electronic thermal	1,2
B022	overload restriction level	1,8
C026	alarm relay function	03
C036	alarm relay active state	00
C041	overload warning level	1,2