

MODULAR FLUIDIZED BED GASIFICATION

Description

*Document is based on
a document issued by a manufacturer,
you may contact us
to get additional in formations.*

FLUIDIZED BED GASIFICATION

OVERVIEW

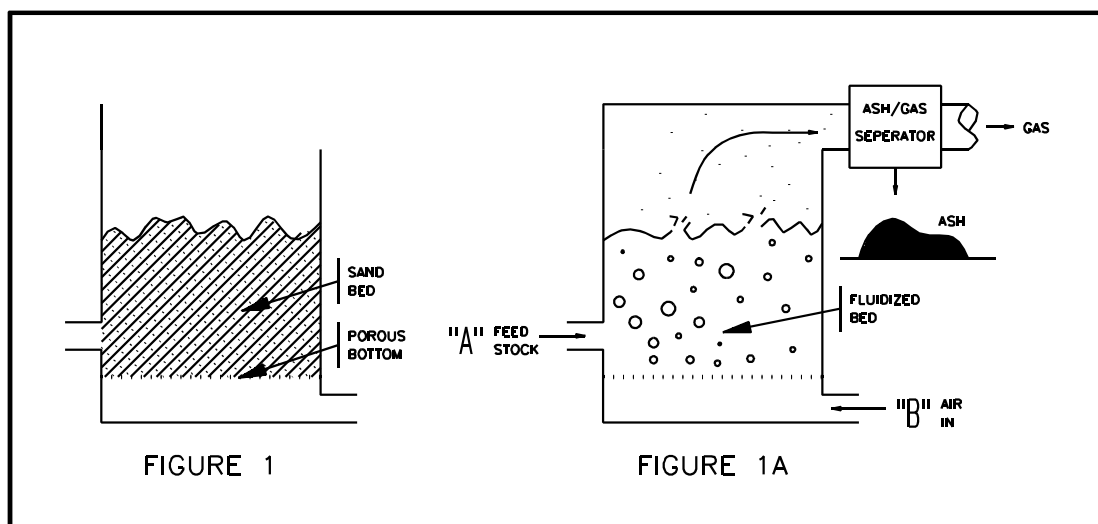
Fluidized bed gasification has been successfully used to convert prepared wastes (*i.e. wood wastes, bark, agricultural wastes, and RDF*) into a clean fuel gas that can be used to fire various types of industrial equipment. Past applications have included gasification of wastes to provide gas for dryers previously fired on natural gas. Fluidized bed gasifiers also have applications in the lumber and plywood industries where they can be used to fire small boilers and direct fired dryers and kilns that are currently fired on expensive natural gas or oil.

Advantages include:

- Reduced cost of boiler or dryer/kiln operation by using wood and or bark wastes rather than gas or oil.
- Reduced cost for additional steaming capacity compared to new wood and or bark fired boilers.
- Reduced dependency on external fuel sources for propane, natural gas and oil.

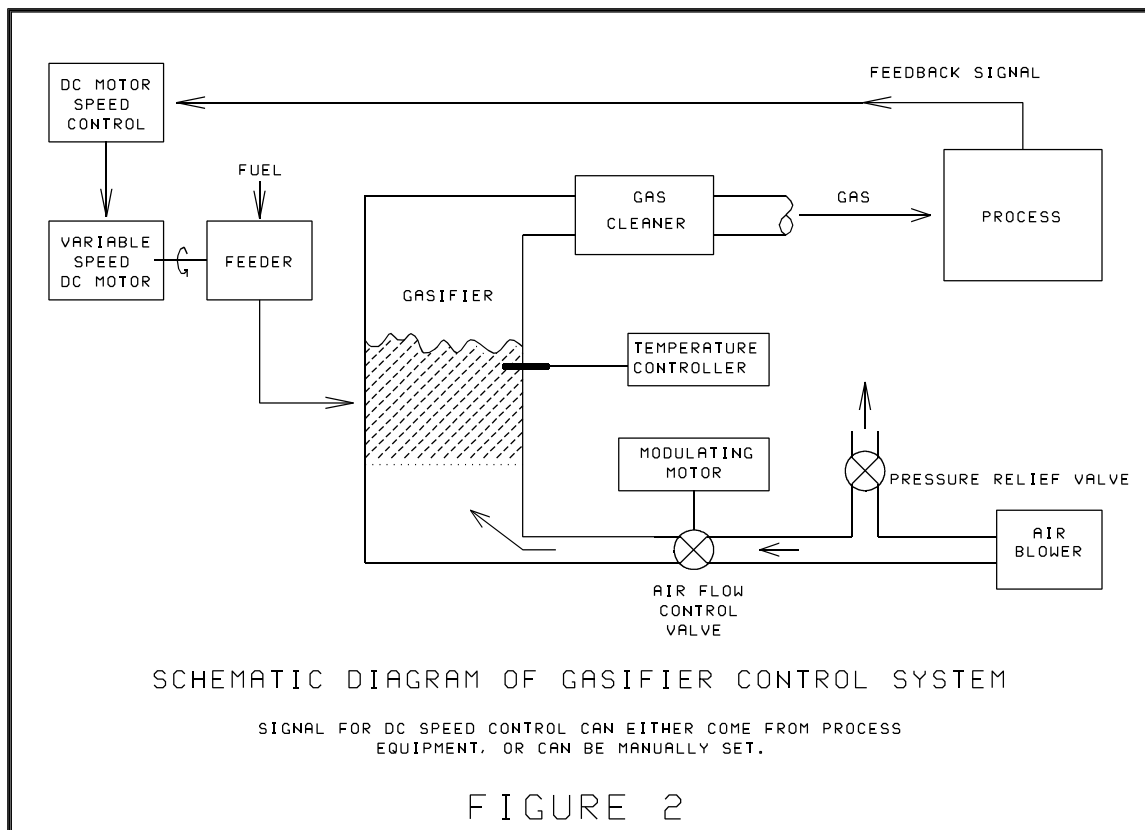
FLUIDIZED BED TECHNOLOGY

To understand a fluidized bed, refer to figure 1, and imagine a container filled with fine sand having a porous bottom. If air is forced through the bottom, it seeps through the sand as shown in figure 1-A. If the airflow is increased a point is reached where the sand particles separate to let the air through, and bubbles form which mix and churn the sand. The sand bed takes on a fluid-like character, and the bed is violently mixed and agitated. This is a fluidized bed.



FLUIDIZED BED GASIFICATION

In fluidized bed gasification, the sand bed is preheated to a temperature of 1000°F. Solid or liquid waste are injected into the bed, and when they are mixed with the hot sand, the wastes are quickly decomposed into a combustible gas. The flow of air is controlled so that only about 25% of the incoming wastes are "burned" in the bed to raise and maintain the temperature at 1500°F. The remaining material is decomposed into gas. Once the bed is preheated, no more fossil fuels are needed. The wastes supply all required heat. The process is shown in figure 2.



The fluidized bed system is made in such a way that the ash particles are carried out of the bed with the gas stream. This ash is then removed from the gas stream by a special ash removal system.

The hot cleaned gas is then directed to a special burner that can burn the hot gas while producing low emissions. Any gravel or stones in the incoming fuel can be removed by periodically extracting some of the sand from the bottom of the bed while it is operating, screening to separate stones from the sand, and then reinjecting the sand into the bed. Because the primary product of the process is a gaseous fuel and not simply heat, the process is called "fluidized bed gasification".

BENEFITS OF FLUIDIZED BED GASIFICATION

The fluidized bed gasification process offers several substantial benefits compared to simple burning processes, and other forms of gasification.

Highly Efficient

The overall thermal efficiency of fluid bed gasifiers is typically in the range of 75% to over 90%, depending on the ash and moisture content of the fuel.

Tolerates Many Feedstock

Unlike some burners (such as suspension burners) or old style fixed bed gasifiers, the fluid bed gasifiers can operate satisfactorily with highly variable feed materials ranging from coal, shredded wood and bark to sawdust fines, or lump wood with particle sizes of less than 1 1/2 - 2 inches. In contrast, other types of gasifiers or burners require either dry pellets, nuggets of clean wood, or uniformly dry sanderdust. Thus the various types of fuels generally available around lumber mills can be used in fluid bed gasifiers with good results.

Highly Reliable

The fluid bed gasifier does not have moving grates or other moving parts in the high temperature regions of the bed. Where there are moving parts, heavy duty industrial components proven in lumber and pulp mill operations are used. Reliability is thus high.

Compact

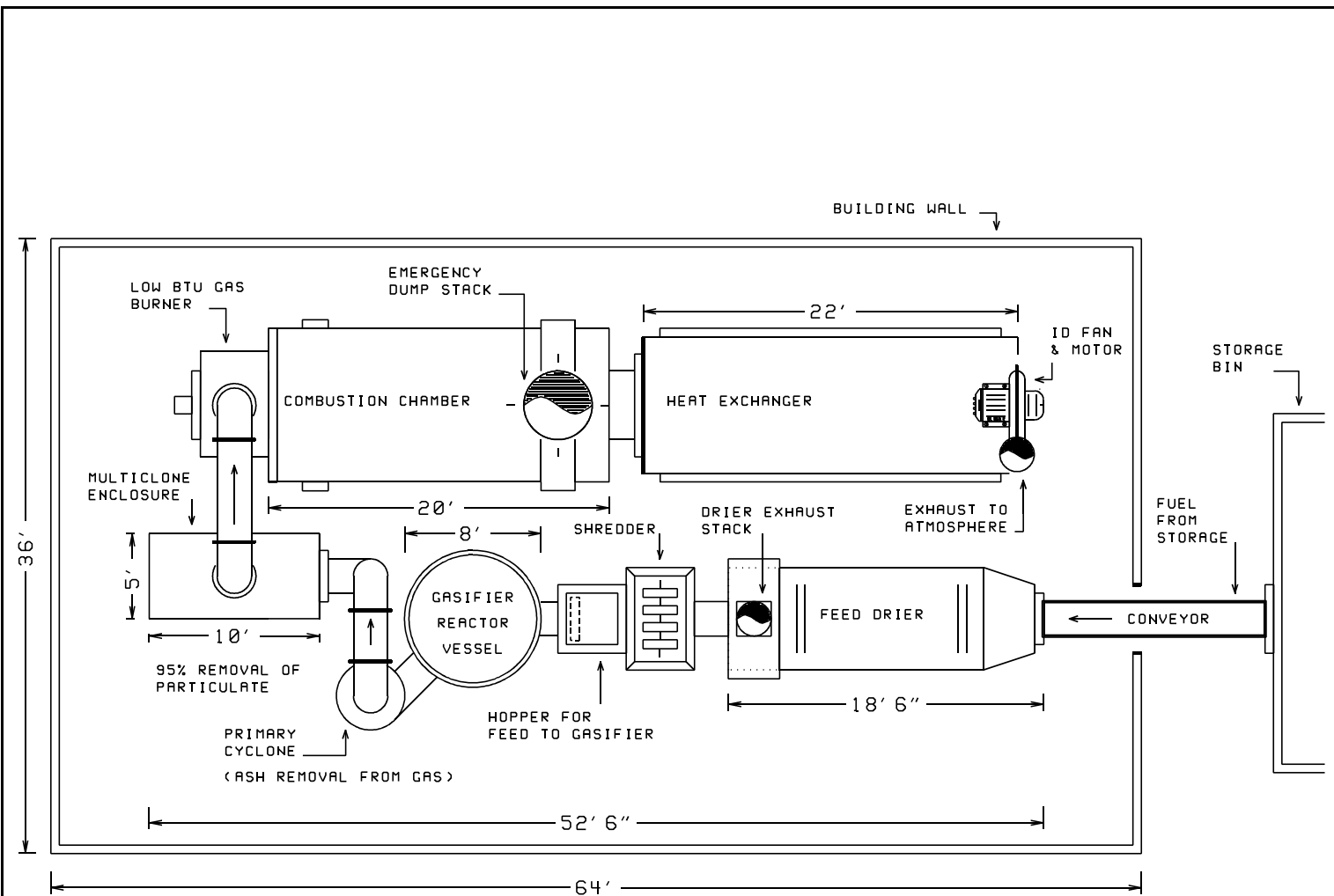
The size of energy conversion systems is generally dictated by their air flow. Because fluid bed gasifiers use comparatively small amounts of air, the equipment is comparatively small and compact. This permits systems to be completely shop fabricated and assembled on skids thereby reducing purchase price and installed costs.

Flexible Operations

Because the process produces a fuel gas rather than just quantities of heat, it can be easily applied to a variety of industrial processes including boilers, dry kilns, veneer dryers, or several pieces of equipment at once.

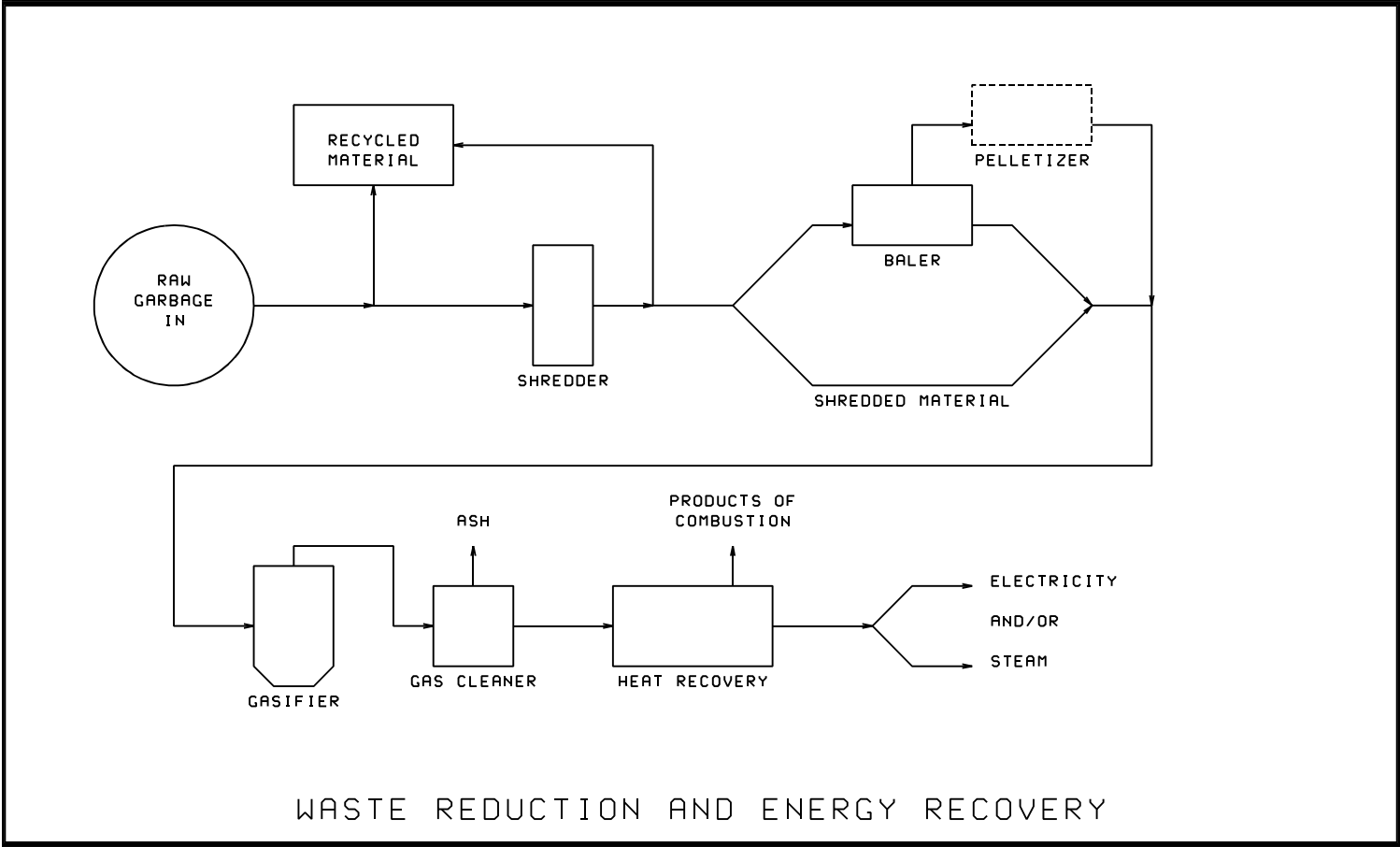
Low Emissions

Operation with wood/bark fuels results in very low emissions, including low NOx, carbon monoxide, and particulate emissions. No "tail end" exhaust cleanup devices are required.



HEAT PLANT BUILDING LAYOUT

FIGURE 3



MODEL 60 GASIFIER/COMBUSTOR

Component List and Description

1. Storage/feeder hopper to supply wood chips or other prepared fuels to a feeder using metering screws driven by a variable speed DC motor. The hopper is mounted on the gasifier vessel and is sized to contain enough fuel for about 10 - 15 minutes of gasifier operation.
2. Rader Industries rotary feed valve featuring a hard chrome lining, stainless steel rotor c/w gear box, drive, and belt guard, and an adjustable/replacable cutoff knife. The unit has been modified to include two purge air ports to pressurize the buckets prior to opening on the bottom, and two additional ports to blow air into the buckets as they close to clean out any remaining fuel. The air flow to the rotary valve is bled from the main blowers and is adjusted to produce a net flow of air into the gasifier. This prevents the escape of gas/smoke, and the condensation of tars and oils on the rotary valve rotor and nearby cool surfaces.
3. Half pitch screw turning at approximately 90 RPM to pass the required volume of fuel to the gasifier. Construction is of stainless steel. Fuel will be delivered to a point near the centre of the gasifier bed. The unit is driven by a Falk helical shaft gear box (motor included). Heavy duty bearings and seals are used throughout.
4. Dual level distributor of stainless steel construction. It features Centrefeed™ construction wherein the wood chips are introduced into the bottom centre of the main portion of the gasifier bed. This assures uniform fuel distribution throughout the bed without the need for multiple feed ports. The distributor assembly includes a central drain port where bed material can be drained after being cooled to about 500°F. Tramp materials will be concentrated above the drain port to minimize the amount of sand required to be drained for screening to remove tramp material.

5. Sand screening and extraction system to remove sand from the bed, screen the sand, and reinject it into the bed. Sand will be simultaneously transported and screened via an inclined vibrating screen conveyor which will separate the tramp and ash material from the sand. The sand will then be elevated via a conveyor, and dropped through a pressure sealing rotary valve either into the injection conveyor or via an inclined fill port above the top of the bed surface.

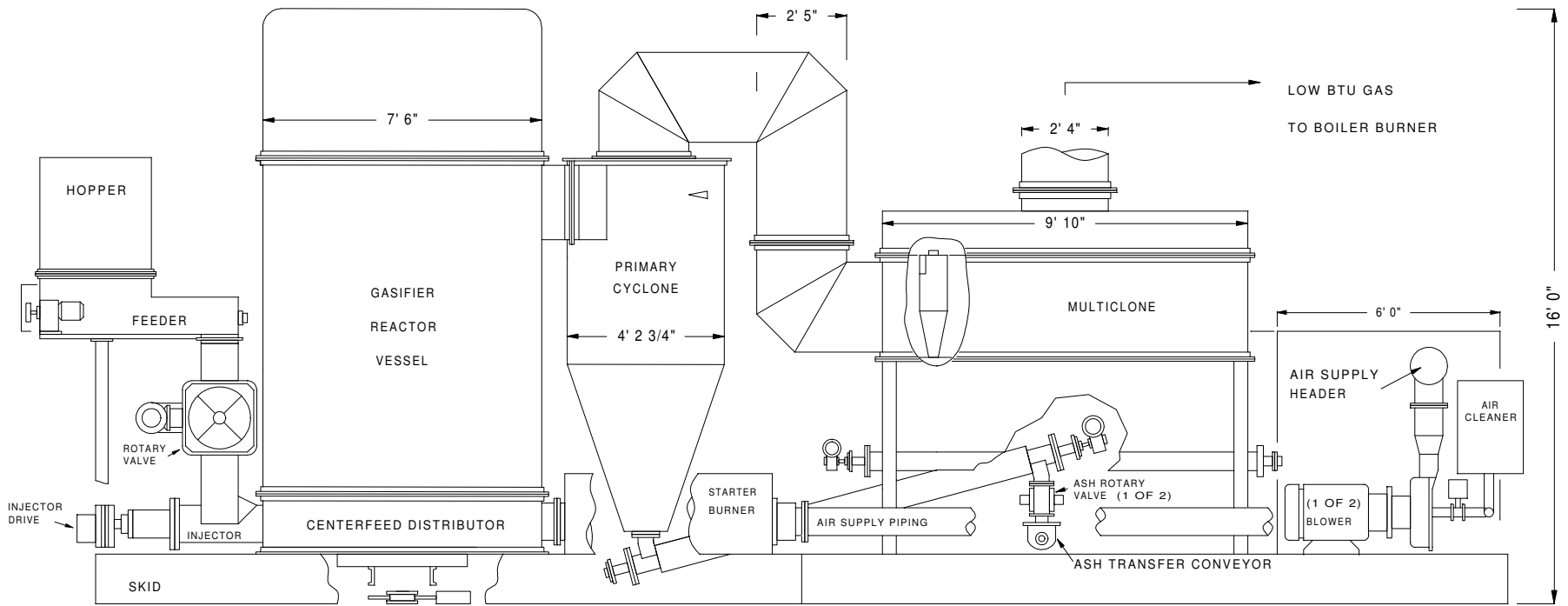
6. Model 60 fluidized bed gasifier vessels capable of a maximum gas production rate of 100 MM BTU/hr. The system is complete with oil, natural gas or propane backup capability, forced draft fan, motor, motor starter, dampers, CSA approved fuel train, and necessary combustion controls. The 3/8" shell of the vessel is lined with 1" dense fiber insulation and 4" of castable refractory which is reinforced with 1/4" x 3" angle ring flanges. The bed vessel is topped with a flanged lid approximately 4 feet high, which increases the volume of the free board to assist in disengaging the gas flow from the sand. The actual bed vessel is demountable from the distributor assembly.

7. Model 60 primary cyclones. This unit is lined with high density abrasion resistant refractory to minimize the effects of erosion. Approximately 70% of the ash exiting the gasifier will be captured in this cyclone as particles larger than 15-20 microns in diameter. Ash drains out of the cyclone to an ash cooling conveyor which consists of a screw conveyor with a stainless steel screw, water jacketed enclosure, and special, air cooled, proprietary shaft seals at either end of the conveyor. The ash cooler reduces the ash temperature from 1,500°F to 400°F prior to passing through a pressure sealing rotary valve. This rotary valve is of heavy duty construction with high temperature bearings, hard chrome lining, and stainless steel wear strips. Ash is discharged into an enclosed screw conveyor for transport off the skid.

8. Model 60 secondary cyclones system consisting of 16 high efficiency units, with ash draining into a combined ash conveyor/cooler which gathers the collected ash and drops it through another heavy duty rotary valve feeder into the ash disposal conveyor. The secondary cyclones will collect approximately 25% of the total ash

exiting the gasifier in the gas stream, with the collected particulate being predominantly larger than 5 microns in size. The secondary cyclone is refractory lined and insulated, and gas exits out the top of the enclosure via an insulated gas duct.

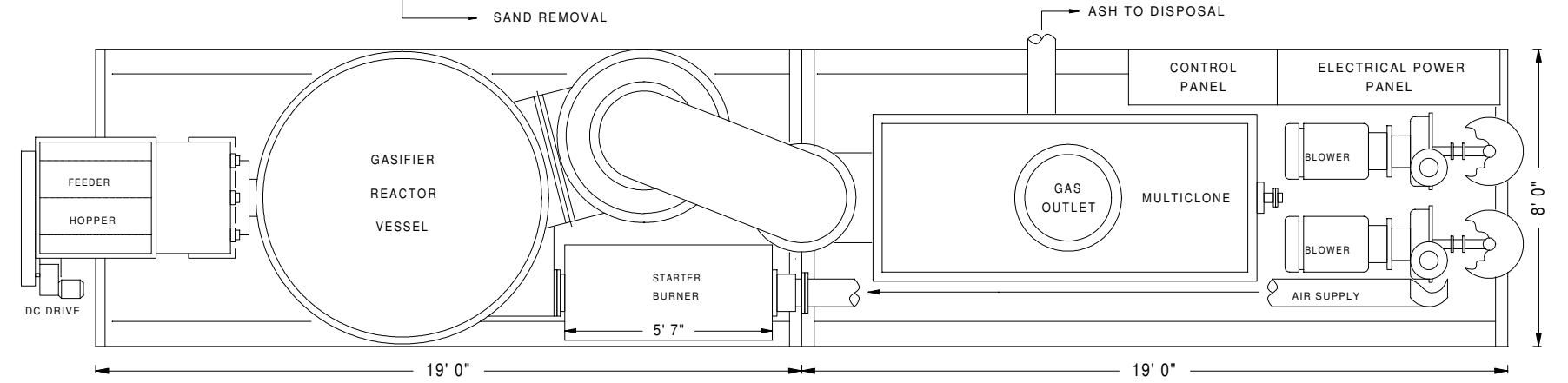
9. Model 60 gasifier air supply systems consisting of two high speed industrial, centrifugal, gear driven fans (motors included). The high speed centrifugal blower offers better efficiency, lower noise, and a more compact package than a roots-type blower. The quantity of air supplied to the gasifier is controlled by butterfly valves positioned by modulating motors and located at the blower inlets to eliminate the need for blow off air (except during start up). This configuration also reduces power consumption when operating at less than maximum air flow. The blower also supplies plant air for seal cooling and purge functions throughout the system.
10. Model 60 starting burner systems consisting of a starting burner, associated combustion chamber, flame safeguard equipment, temperature controllers, over temperature protection, ultraviolet scanner, and other features normally associated with industrial quality burner systems. Used only for start up, this burner heats the air stream using natural gas regulated to 7-10 psig supply pressure. The maximum air temperature is controlled to 1,200°F, and the air heats the bed and the refractory along the gas flow path to about 1,000°F before the wood chips are fed into the gasifier. Feeding in the wood chips raises the temperature the rest of the way to the normal operating temperature.
11. Model 60 combustors designed to give a 0.3 second retention time with a 2,200°F exhaust temperature when operating at design capacity. The combustors have a nominal capacity of 60 MM BTU/hr heat release, and measures approximately 108" diameter by 237" long. It is constructed of a 3/8" mild steel shell lined with 2" of mineral block insulation rated at 1,900°F and 4" of high density castable refractory (130#/cu.ft.) with a temperature rating of 2,800°F. The combustor package includes a special dual fuel burner (low BTU gas and natural gas), necessary fan and assembly, and CSA approved fuel train and controls.



LOW BTU GAS
TO BOILER BURNER

SAND REMOVAL

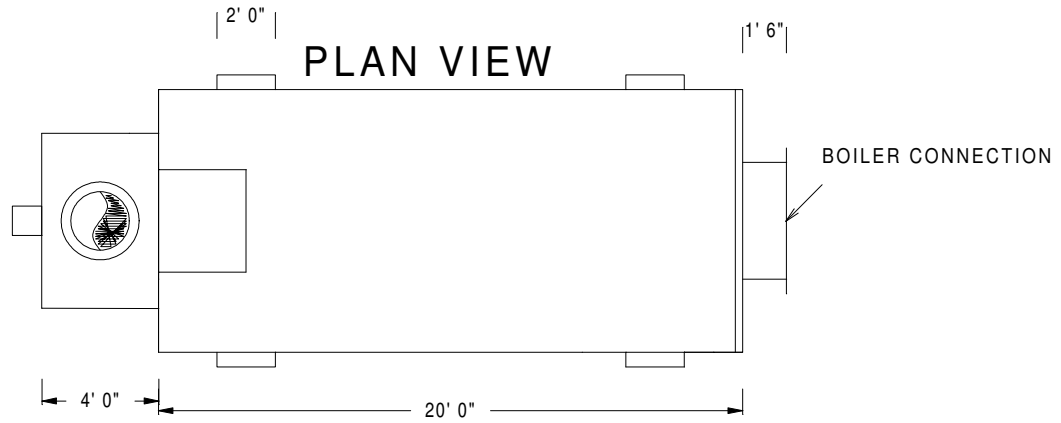
ASH TO DISPOSAL



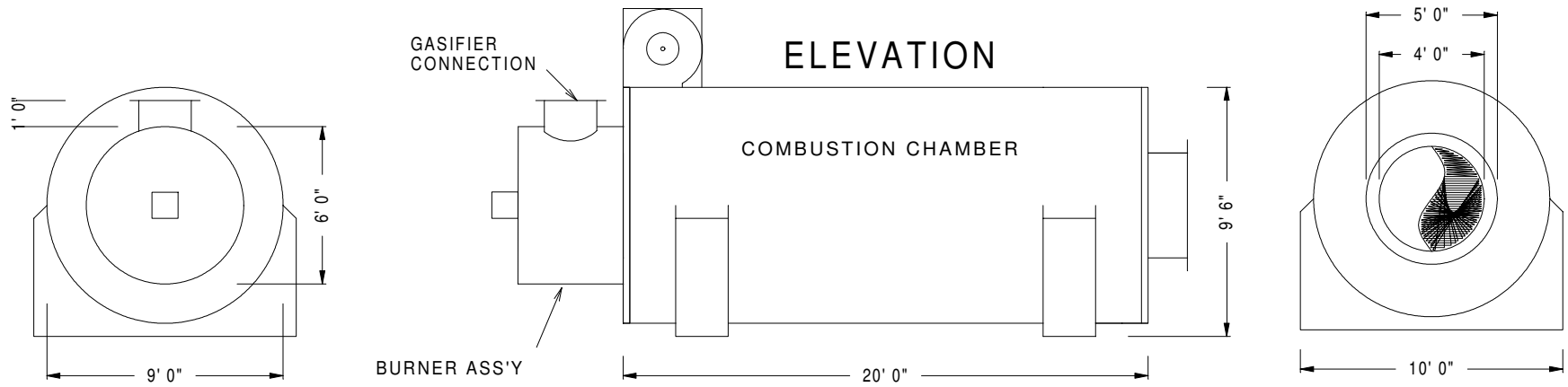
MODEL 60 FLUID BED GASIFIER

MODEL 60 COMBUSTOR

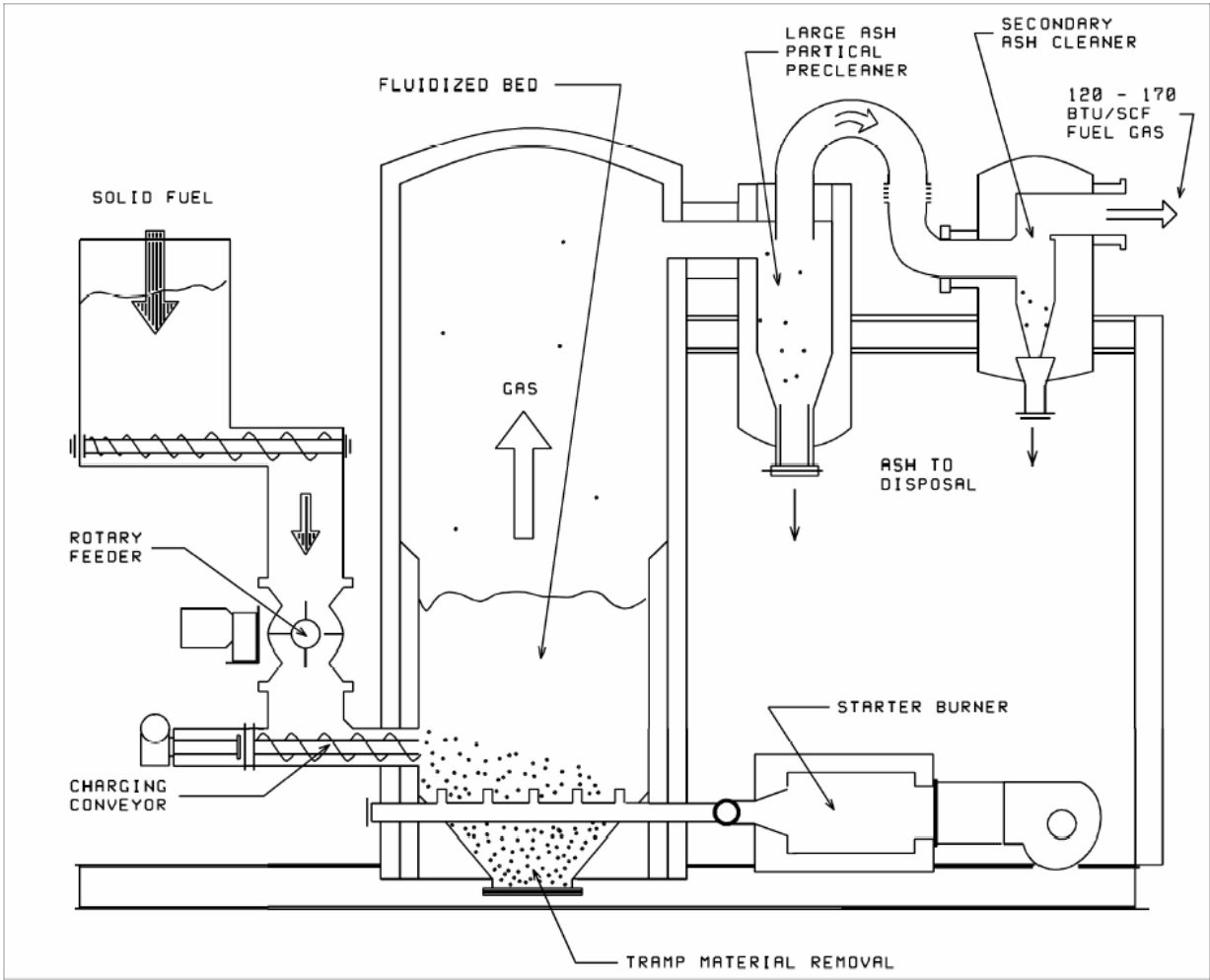
PLAN VIEW



ELEVATION

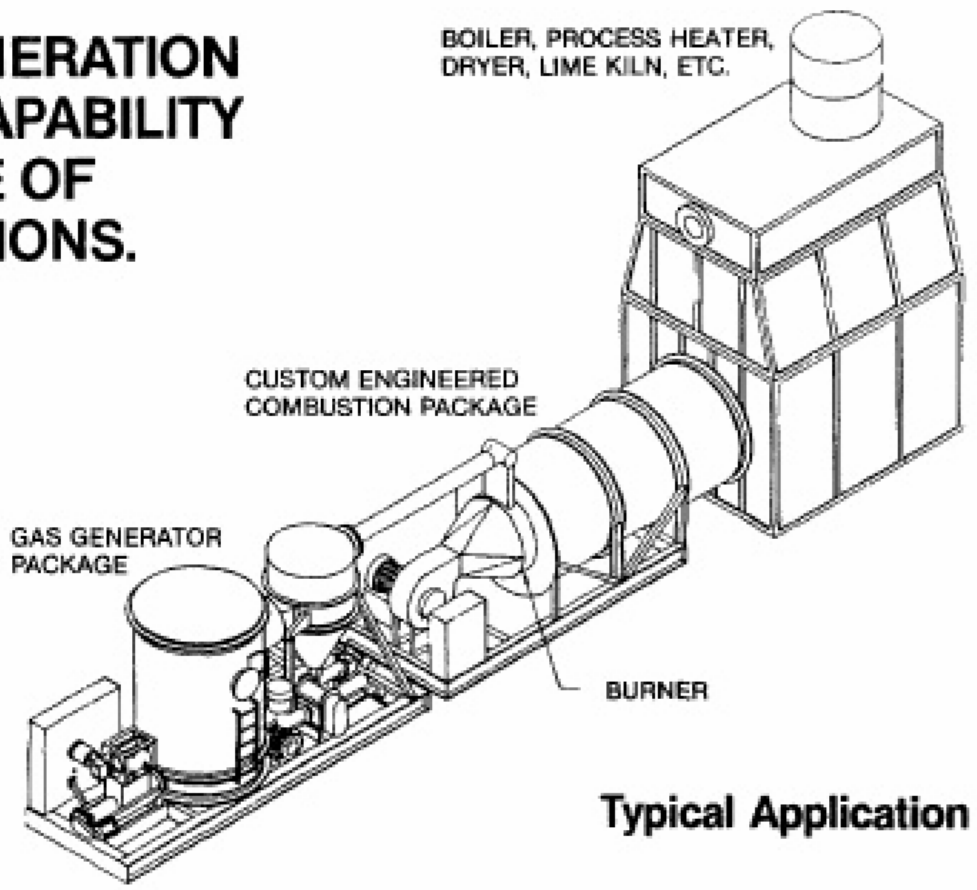


MODULAR FLUIDIZED BED GASIFICATION



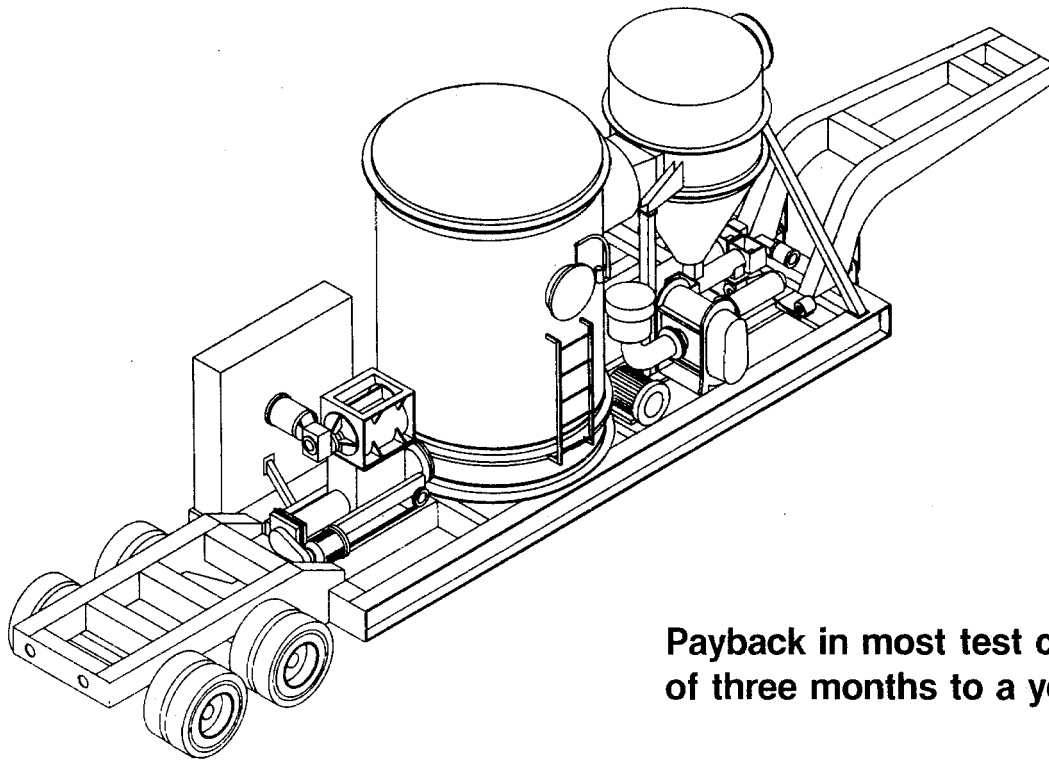
TOTAL FUEL GAS GENERATION AND COMBUSTION CAPABILITY FOR A BROAD RANGE OF POTENTIAL APPLICATIONS.

Substitution for fossil fuels, boiler supplementary firing for increased steaming output, cogeneration systems, dryers, lime kilns, process heaters, etc.



Typical Application

HIGH PERFORMANCE WITH REASONABLE COST IN PACKAGED FUEL GAS GENERATORS



**Payback in most test cases
of three months to a year.**

FEATURES:

- **Demonstrated Performance:** Technology proven on high ash (20% + ash content) fuels.
- **High Efficiency:** Better than direct combustion systems.
- **Complete Package:** Shop fabricated, wired, and tested. Shipped as a road-legal package to job site. Gooseneck and wheel assemblies removed at job site.
- **Minimum Cost:** Preassembly minimizes initial cost, delivery time, and installation/field erection/shakedown expenses.
- **Fuel Flexibility:** Capability to handle difficult, high ash fuels and fuels prone to severe ash fouling and slagging.
- **Reduced Emissions:** Reduced particulate emissions with high ash fuels. Reduced NOx emissions with high nitrogen fuels. Sulfur suppression also possible.