The GEK Gasifier
Fig. 8-3. Typical vehicle gasifier system showing cyclone and gas cooler  (Source: Adapted from Skov 1974)
GEK v2.0 Main Assembly
Gas Cowling, Reactor, Hopper
GEK v3.0 Downdraft Reactor with air preheating

3" reduction restriction configuration
GEK 11'' Reactor with J–tube air preheating

3'' Imbert Hourglass Hearth
GEK PyroCoil Heat Exchanger

Double shell gas circulating heat exchanger inserts into reactor and drives pyrolysis zone with IC exhaust or other external heat source.

Auger Motor

Exhaust Out

Gas Directing Baffles

Auger Attach Flange

Tar Circulation Holes
Through cooling holes so tar can circulate upwards in center and down on outside via passive convection, or active ejector venturi nozzle circulation.

Exhaust In
GEK Auger fuel feed and fuel drying/preheating system

Auger Doghouse or PyroCoil reactor attachment

Auger Doghouse Ltd:
- Attaches auger to reactor. No heat exchange.
- Use one or the other. Not both.

PyroCoil:
- Heat exchange shell to return IC engine exhaust heat to pyrolysis zone in reactor. Replaces Auger Doghouse.

Downdraft Reactor:
- Auger Doghouse or PyroCoil connects auger to reactor. Doghouse bolts to top of reactor. PyroCoil inserts down inside reactor.

Stirrer Motor

Gas Out

Auger Motor

Drying Bucket and Fuel Feed Auger:

Cyclone:
- Cyclone output attaches directly to bottom of auger double jacket.

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A patent is also pending to enforce the intended rights and responsibilities, until open hardware licenses are better established.
For more information on building details and use rights, contact “gek@allpowerlabs.org”
GEK Tower of Total Thermal Integration
Air Preheat / Drying Bucket / Pyrocoil / (& no radiator)

Heat Exchanger #3
Air Preheating - Syngas Cooling

Heat Exchanger #2
PyroCoil: IC Exhaust - Pyrolysis Zone

Heat Exchanger #4
Cyclone with Steam Coil

Heat Exchanger #1
Drying Bucket

Monorator Hopper

Filter

gas out

Stirrer

Auger

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GEK Tower of Total Thermal Integration  
*(The Hot TOTTI)*

**Heat Exchanger #1**  
Drying Bucket  

**Heat Exchanger #2**  
PyroCoil.  
Double jacketed heat exchange shell to return IC engine exhaust heat to pyrolysis zone in reactor. Internal baffles direct flow around shell to maximize heat exchange.

**Heat Exchanger #3**  
Air Preheat / Syngas cooling.  
Standard GEK downdraft reactor inside Gas Cowling. PyroCoil inserts into reactor. Air intake lines made from flex corrugated ss air intake lines wrap around reactor, in annular space between reactor and gas cowling. Incoming air is heated by outgoing gas. Outgoing gas is cooled by incoming air.

**Heat Exchanger #4**  
Cyclone with Steam Coil:  
Cycone output attaches directly to bottom of double jacketed drying bucket. Water jacket or heat exchange coil around cyclone vessel to generate steam for reinjection into reactor. Steam coil fed with recirculating filter water.

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GEK Triple Hips Downdraft Study

Proposed GEK downdraft reactor insert with four zone separation, internal tar recycling, upward convection pyrolysis, and open swirl combustion chamber.

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Layout for CNC Plasma Cutting

(Cut from 1/16" thick mild steel sheet)

(Cut from 1/8" thick mild steel sheet)

Hatched areas are desired parts. Clear areas are drops. Three sets of flange rings and end plates can be cut from one 4' x 8' sheet.

All cuts should note male and female edges and configure machine cutting offset accordingly.

The bottom left and center circles each have two closely nested parts. When cut on the internal line, the 0.05" plasma cut width forms an offset equal to the thickness of the corresponding vessel tubes. One circular piece will mount around the outside of the tube. The other will mount on the inside of the tube.

The top row has one solid reduction bell end plate for user sizing, and three additional ones with precut 5", 4" and 5" ID centers.

(y0.8. Before building, check www.allpowerlabs.org/gasification/gek for most recent version before building.)

ALL Power Labs, 1018 Murray Street Berkeley, CA 94710. 4/18/08. jimmmason@whatisamupto.com
GEK Flange Rings and End Plates v3.0
(Cut from 1/8" mild steel sheet)

**Gas Cowling**
- Top Flange
- Bottom Flange

**Downdraft Reactor**
- Top Flange
- Bottom End Plate
- Perimeter Mounting Flange
- Reduction Bell End Plate (for cut center to desired size)

**Hopper, Filter, Cyclone, Fan, Burner, Grate**
- Top Cover for Reactor or Hopper (holes for fuel fill and top down air config)
- Swirl Burner
- Ash Grate (for exit with holes)

Before building, check for more recent versions at: www.gek-gasifier.com

ALL Power Labs, 1010 Murray Street, Berkeley, CA 94710, 8/09, jimi@allpowerlabs.org
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GEK Vessel Tubes v3.0: rolled from flat sheet
(Cut from 1/16" thick mild steel sheet)

Downdraft Reactor Outside

Downdraft Reactor Inside/Insulation

Gas Cowling

Cyclone

Swirl Burner

Air Neck

Packed Bed Filter

8" Diameter On Center
(with 3/8" sheet overlap at joint)
GEK Scale-up Sizing Steps

Each step based on common North American tank sizes.
Gas flow rates estimated with traditional Imbert sizing chart.

Small Block GEK 7.5-3-4 inch constriction

Big Block GEK 4-6-8 inch constriction

Mountain GEK 5-8-10 inch constriction

Merlin GEK 8-10-12 inch constriction
Biochar Experimenters Kit (the BEK)

Multiple mode Pyrolysis Reactor for characterized Biochar making

Full System for $4395. 10% off on purchases during conference
ALL Power Labs. www.gekgasifier.com. gek@allpowerlabs.org

Biomass Hopper
Open top or closed top.

Swirl Burner
Clean burning flare runs on premixed tar gas and air.

Ejector/Venturi Gas Pumping, Air/Fuel Premixer
No fan to burn up with hot or combusting gas. Air premix built in for clean stoich flare. Propane support for smokeless start up and shut down.

Biomass Feed Auger
Connects to hopper.

Biochar Reactor
Inserts into standard GEK gas cowling. Supports multiple pyrolysis modes in direct combustion, indirectly heated retorts, and hot gas recycle through bed architectures. Temperature, residence time, pyrolysis modes are fully controllable for characterized Biochar making.

Gas Recycle Loop for Retort or Through Bed
Driven recycle loop with variable hot flue gas intake to loop. Loop is "cold", flue gas is "hot", mix for desired recycle temp. Driven loop increases heat transfer rate through vessel walls.

Baffle Plates

Gas Cowling Base for Biochar Reactor
Standard GEK base cowling creates outer vessel for retort and insulation layer.

Biochar Auger Take-off
Connects to user provided hopper.