

# Understanding Atomizing Waste Oil Burners

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## What is Atomization:

- Creating a fine vapor-like mist of fuel - through or across a nozzle with a very small orifice
- Maximum fuel *surface area* to combustion air ratio.
  - Availability of oxygen: same reason kindling burns brighter and faster than firewood

## Atomizing Oil Burners

- “Gun Style” is a typical burner for household furnace
  - Very tight design, safe and reliable
  - Requires refined fuels, oil is ‘pushed’ through a small nozzle
- DIY atomizing nozzles
  - Can be very simple in design
  - Usually require high capacity air compressors
- Siphon nozzles
  - Factory made nozzles for retrofitting gun style burners to wider range of fuels
  - Requires high capacity air compressor
- Babington nozzle
  - Oil stream lands on ‘ball’ and spreads out thinly over fine stream of compressed air
  - High degree of atomization, little filtration necessary
  - Smaller air compressor can be used
  - Not without it’s problems - many variables

## Why waste oil?

- Economy
- Resilience
- Full circle - waste becomes a resource
- Predictable, steady output compared to other biomass heat sources
- On a working farm or garage, chances are, you already have some waste oil

## “Waste” Oils:

- Varying degrees of *Viscosity*, and viscosity response to temperature changes
- Varying degrees of *Heat Value* - expressed as btu/gallon (generally 100-150k)
- Graded petroleum oils: #1-6. #2 heat value: 137K btu/gallon.
- WMO - Waste motor oils. Estimated 125K btu/gallon
- WVO - Waste Vegetable Oils.
- Pyrolysis Oil - ‘bio-oil’ ‘tar or pitch’. Estimated 65% heat value of #2 fuel oil.

## Disclaimer

- We are not recommending modifying existing household furnaces (insurance!!!)
- Experiment at your own risk - know your limits
- Fuels can have explosive vapors, use caution.
- Know the side effects of skin contact, inhalation of vapors.

### ***A nod to the pioneers of this work:***

- Jesse Parris and the thousands of members of online forums- altfuelburnace, altfuelbabington, wastewatts
- Robert Babington, inventor of Babington nozzle technology
  - Now used widely in remote military cooking applications

## **Oil Burner Designs**

### **Drip Style**

- Low Tech. No atomization.
- Natural Draft possible (no electricity)
- Mother Earth News' design is widely used. Designed in 1970's.
- Today's motor oil has additives that resist degradation and allow engines to run at higher temperatures. In effect, waste oils are now much harder to burn cleanly and likely require preheating and atomization.

### **“Gun Style”**

- Conventional fuel oil burners
- Modest efficiency improvements over time - although overall burner design hasn't changed much
- As homeowners upgrade to modern heat pumps, these old style burners are ubiquitous in scrapyards and can be purchased for very little cost.
- Most can be operated without modification with up to 20% biodiesel. (B20)
- Predictable issues with higher ratios of biofuels - 'gelling' and damage to rubber seals. Commercial biofuel safe pumps and preheaters available.
- Very convenient, tight design.

### **Siphon Nozzle**

- Requires high capacity air compressors
- LP can be used in lieu of air
- Fuel pumps not required
  - Preheating for reliable viscosity
  - “Constant level device” to maintain consistent fuel flow
- Simple DIY nozzles can be made from off the shelf hardware
- Manufactured nozzles available for retrofitting gun style burners for Waste Oils

### **Babington Style**

- Fuel flows OVER nozzle, rather than through nozzle
- Imagine fine mist from a whale's blowhole
- Filtration matches your pump - not your nozzle
- Requires sump and pump
- Same preheating issues with alternative fuels

# Components:

## The Burner

### Nozzle

- Very small hole req'd. Difficult to drill.
- Subject to degradation over time

### Sump

- Any vessel will work. Think safety with open fuel containers

### Pump

- Probably most vulnerable part of system. Requires constant operation.

### Atomizing propellant

- High capacity compressor necessary for any siphon nozzle
- Also requires constant operation. **Consider noise.**
- Refrigerator compressor possible for babington nozzle. **Consider safety**
- Propane can be used in lieu of air. **Consider safety**

### Ignition

- High voltage transformer and electrodes, continuous duty
- Spark plugs, LP torch heads, electronic stove igniters, etc

### Combustion Air

- Additional air necessary for proper fuel/air mix
- High volume, low pressure. Lots of salvage sources - dryers, hot tubs, exhaust fans

### Burn tube

- Has to tolerate high combustion temps
- Can be arranged to provide preheating for fuel and combustion air

## Ancillary Equipment

### Preheat

- Direct exchange: fuel proximity to burner, copper coil around burn tube
- Hydronic: better temperature control
- Band heaters, Plug style heaters, cartridge heaters - control system necessary
- DIY idea - heater from large glue gun placed directly before nozzle?

### Flow control

- Devices to limit motor speed
- Return line on fuel supply to nozzle

### Air control

- Devices to limit motor speed
- Blower dampers

### Ignition Control

- Honeywell R8184G with cad cell and timeout

### Reserve tank

- Float valve controlled.
- Necessary to maintain fluidity - preheat may be necessary

### Burn chamber

- Necessary for clean operation
- Built right for flame pattern: direct hit of flame on sidewall will eventually wear it out
- Refractory helps retain heat, helps flare off any dripped oil

## Applications

- Water heating
  - Domestic
  - Industrial/Agriculture
  - Space Heating
- Furnaces for space heating
- Lumber kilns
- Glass and Ceramics kiln
- Soft Metal casting
- What Else?

### At Living Web Farms

- Used to boost temperature of water already heated from biochar manufacturing process.
- Combustion heat is captured in home built stainless steel water heater, can be distributed to greenhouse via Modine heater (radiator and fan), used directly to fill vessels for immediate use
- Fuel is a mix of waste motor oil and Pyrolysis Oil - a very heavy, acidic, byproduct of biochar production
- Experimenting with ways to use heat for drying processes, startup on biochar system (in lieu of wood chips)

## Resources:

Wasteoilheaterforum.com

Yahoo Groups:

Altfueelfurnace  
Altfuelbabington  
WasteWatts

Ckburners.com - supplies

Yellowbiodiesel.com Pre-fab mild steel babington ball - designed for vegetable oil.

[http://www.aipengineering.com/babington/Babington\\_Oil\\_Burner\\_HOWTO.html](http://www.aipengineering.com/babington/Babington_Oil_Burner_HOWTO.html)

<http://www.thsengineering.com/2009/03/waste-oil-furnace-secrets/>

<http://home.cogeco.ca/~woproject/atomizer.html>

WMO - 125K btu/gallon

#2 - 137K btu/gallon

#5 - 150K btu/gallon