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In this guide I will teach you how to produce Ethanol using bad fruits, in my case, I am using apples, but you can use anything that has sugar in it for this process, the bad apples are less expensive than processed sugar.

Before you start producing your own ethanol, you will need to fill in the form that you can find on the download page and apply for an alcohol / ethanol permit. It's free to apply.

TOOLS:

Here are all the necessary tools you are going to need for these project.

First we will need a  and a  to smash the apples.Another tool we use is the  and the

along with the

to fasten some pieces.

We will also use the to solder some cooper pipes.

To cut the cooper pipes we will need a .

One of the tool we will also need is  along with the  to boil and distill the mixture.

These are the tolls you will need to start this project.

Materials:

1or 2 Bags of bad apples;

5 kg's of sugar;

2 packets of yeast;

3 barrels;

Some cooper pipes; Some

cooper elbows.

Step 1: Smashing and mixing:

The first thing is to get some apples. You will need quite a lot of large containers, because you need to collect about 4 to 5 times the volume of apples compared to the volume of juice.
The container shown here is a 5 gallon (22 litre) fermentation bin.

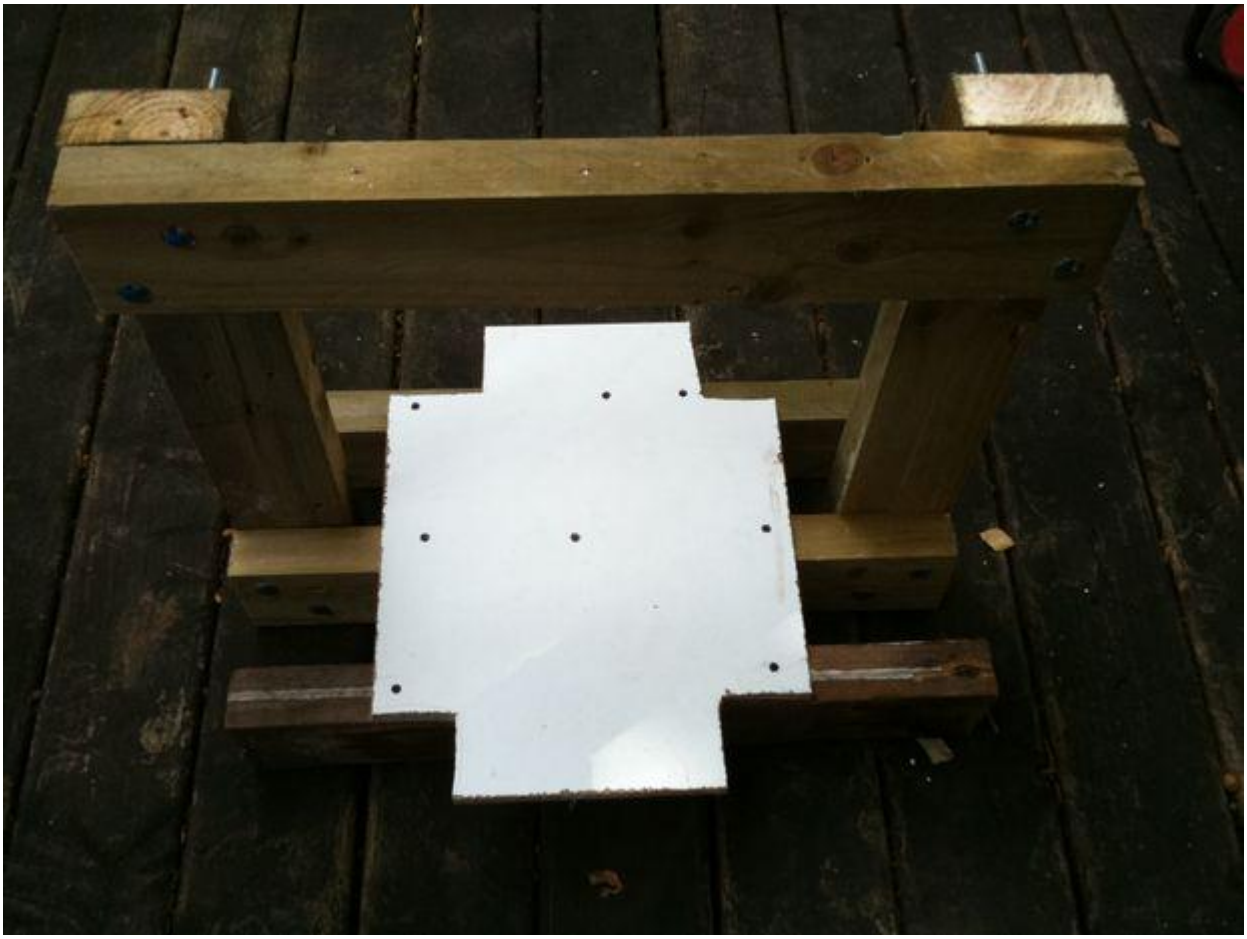
A sheet or blanket is also handy. Put your sheet under the tree, climb up the tree and shake it. Lots

fall off. The advantage of this method is that generally the ripest apples tend to fall off, and seriously under-ripe apples stay on. When you put them into the bucket, pick the apples up by hand, so you don't get all the twigs, leaves, earwigs etc.

You can also buy the apples for as little as 15 cents/kg from your local market.

You need a lot of apples. Here are about 20-22 gallons of apples, which made about 4 and half gallons of juice.

To release the juice, you have to smash up the apples, then press them. A long piece of timber is good for this (untreated with any sort of preservative!)



Here, a press was made from 4" x 3" (12cm x 9cm) timber bolted together. This forms a strong frame in which a tub can be placed.

The mashed apple pulp is put inside a nylon mesh, and put into a plastic box, with a single small hole drilled into it (to let out the juice). The cheapest available was this red mesh, an offcut from the fabric section in a shop.

A board was placed on top of the mesh containing the apple pulp, and a car jack placed between the board and the frame to apply pressure.


young's
Wine Yeast
For White or
Red Wine
Dessert / High Alcohol
Net Weight 5 g

Now I will add water and yeast to the barrel. Although standard yeast can be used, it is best to use ethanol tolerant yeast from a wine-making supply store.

Add between 1 and 2 packets to the barrel.

The wine yeast you add will quickly crowd out any traces of other natural yeasts. It will use up the oxygen in the juice to breed, and will start turning the natural sugars into alcohol.

This will work without adding sugar, but I will add an extra 5 kg's of sugar to have the mix a bit more concentrated.

After I mixed all the ingredients, I will check the sugar content daily with a hydrometer.

Over the course of approximately 10 days, the sugar content should reduce gradually until none is left.

To make sure that the process will run smoothly, the temperature inside the room where you hold the barrel, should be around 20 Degrees Celsius or 70 Degrees Fahrenheit.

If the temperature is higher than that, the process should be completed in a smaller period of time, that's why it's important to monitor the level of sugar.

Step 2: Building the distiller equipment:

There are a few guides out there on how to create stills for various purposes. Usually these include a large amount of small diameter, flexible copper refrigerator tubing. While these stills can be quite effective, there is just something a little hokey about them. Especially the part where you run a large amount of expensive copper tubing through a bucket of standing water to cool the condensate. Then there's the issue of a high surface area on the interior of the tubing, which makes small volume distillations difficult to **impossible**. Plus they're bulky, unwieldy, and they look like a meth lab.

By using a small amount of 1/2" and 3/4" copper pipe, it is possible to build a lightweight, compact, collapsible, interchangeable, universal distillation apparatus for anything you could possibly hope to distill. The apparatus featured in this manual is capable of efficient low to medium volume distillations and could in principle be scaled for use in high volume applications. It is constructed from relatively inexpensive parts which are available at any hardware store.

SAFETY:
This project requires the use of tools and equipment that may be HAZARDOUS if handled improperly. Soldering of copper pipe requires the use of an open propane flame that can cause severe burns and fires. Never point a propane jet at anyone or leave one unattended for any period of time. HOT metal looks like COLD metal.

Distillation is a method of separating liquids that are in solution together, often as a form of purification. However, only proper, professional testing can positively identify the constituents of a given distillate. If you are purifying comestibles, DRINK AT YOUR OWN RISK.

DO NOT use lead solder.
DO NOT use this to distill hydrogen peroxide or any other potentially explosive chemical.
DO NOT allow blockages to form in the distillation pot outlets.
DO NOT use radioactive materials as fractionating column filler.
RESEARCH aluminum and decide for yourself whether it poses any danger.

LEGALITY:
In my own backwards country where the vestiges of prohibition are still rampant, it's illegal to manufacture certain distillates without a permit for the still in question. We'll just leave it at that. I don't think it's a problem to distill anything else, but I haven't checked so don't take my word for it. The same principles apply to ethanol used for fuel, but as mentioned a still must still be registered to distill fuel. Still.

Please visit TTBgov for more information about US law regarding the use of a distillation apparatus. Basically, they make it impossible for a regular person to distill liquor. Producing fuel ethanol is somewhat do-able. All other distillations are ok.

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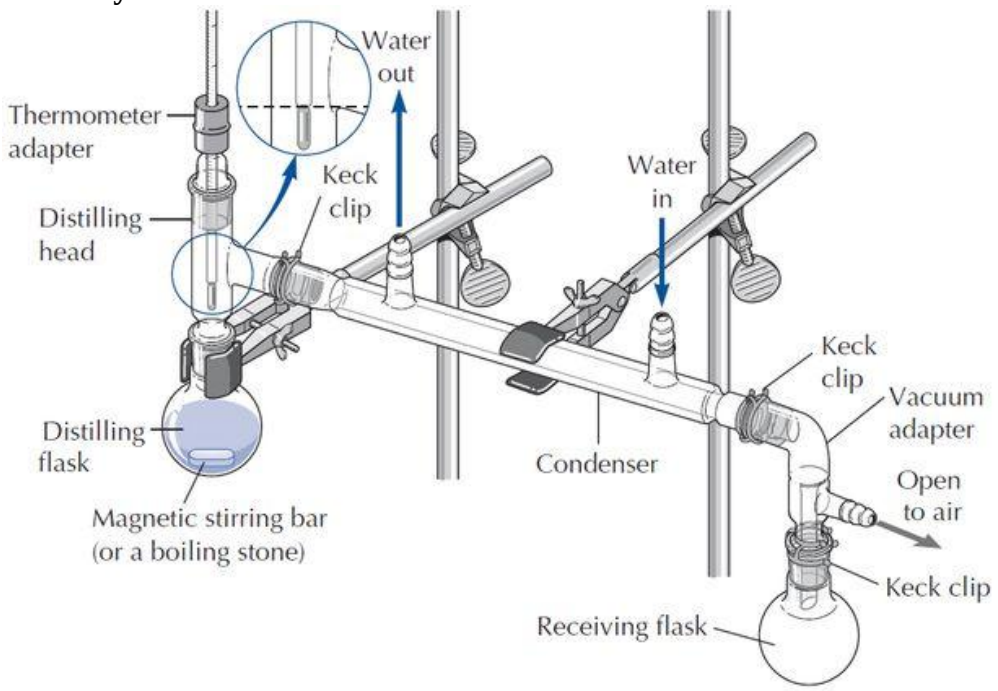
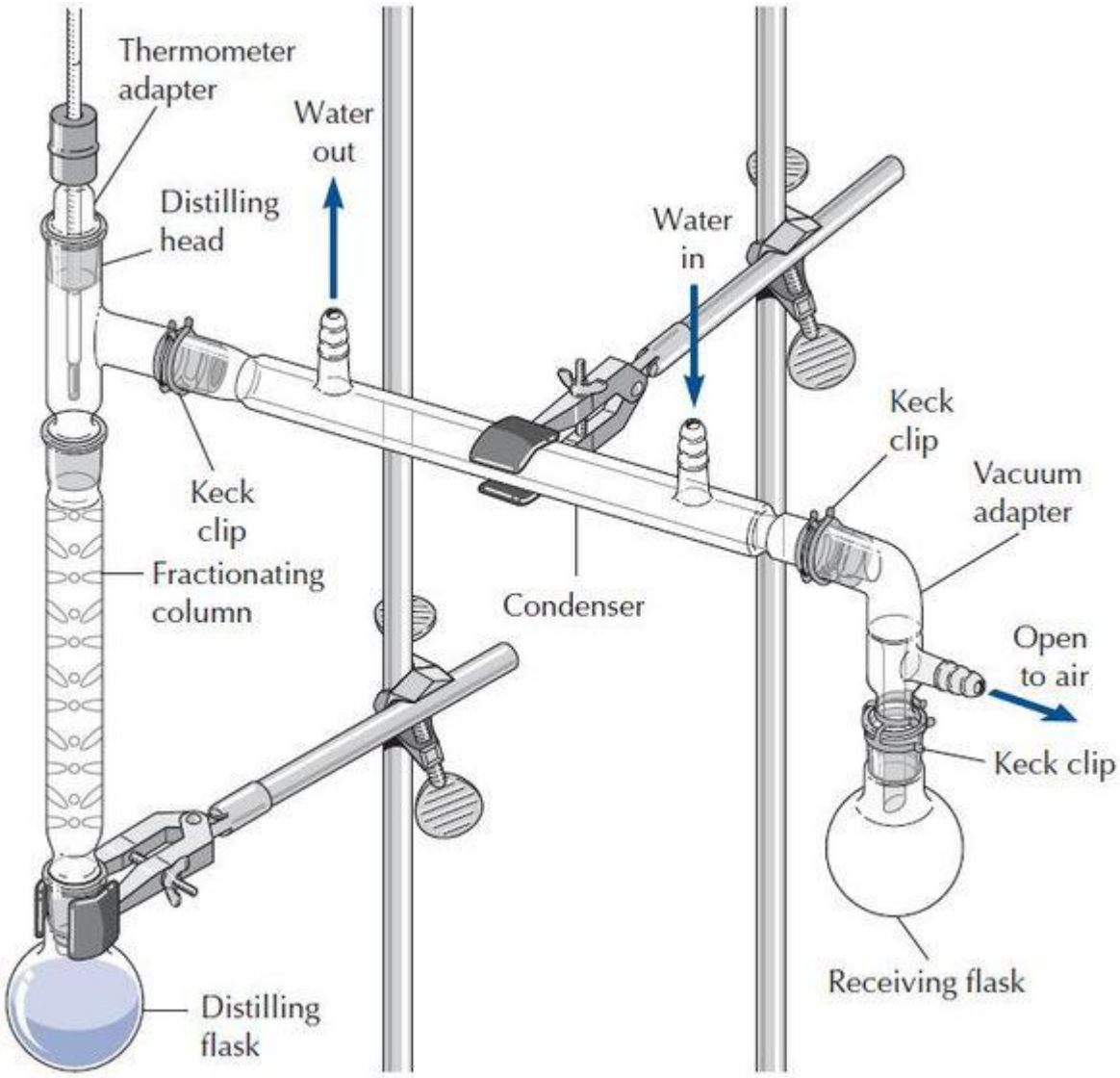
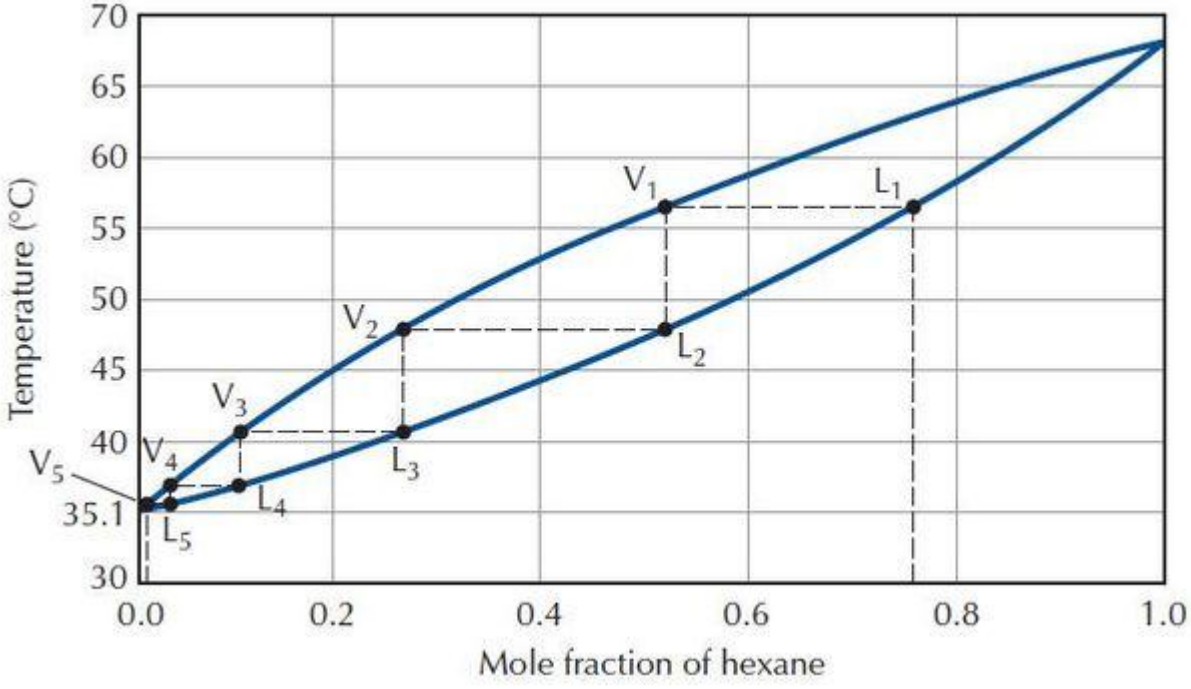
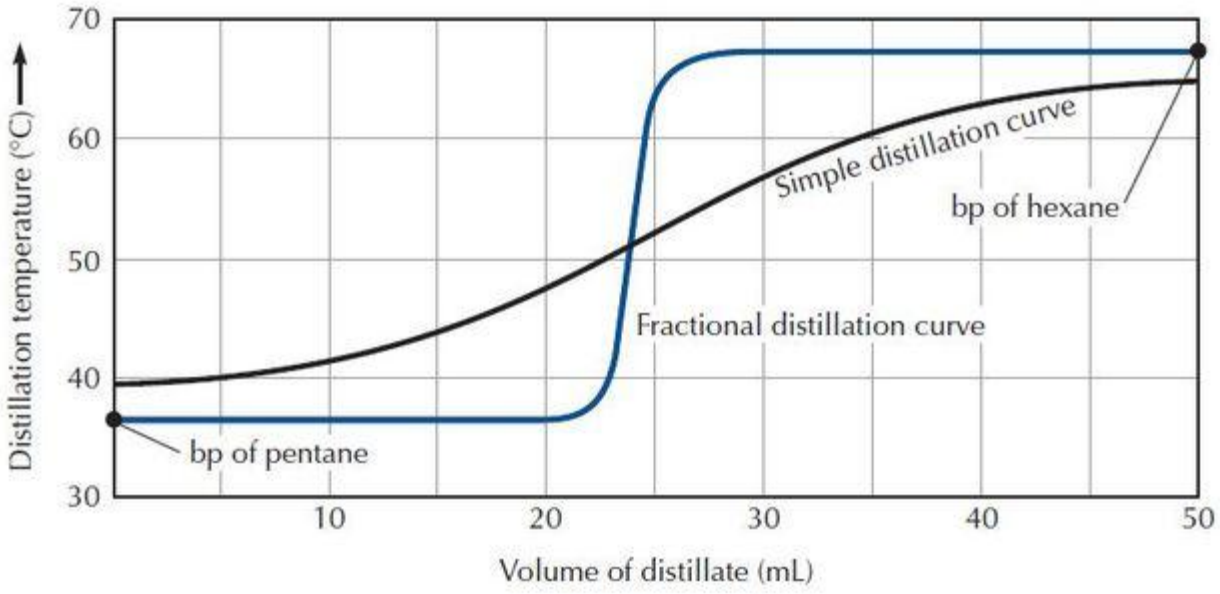
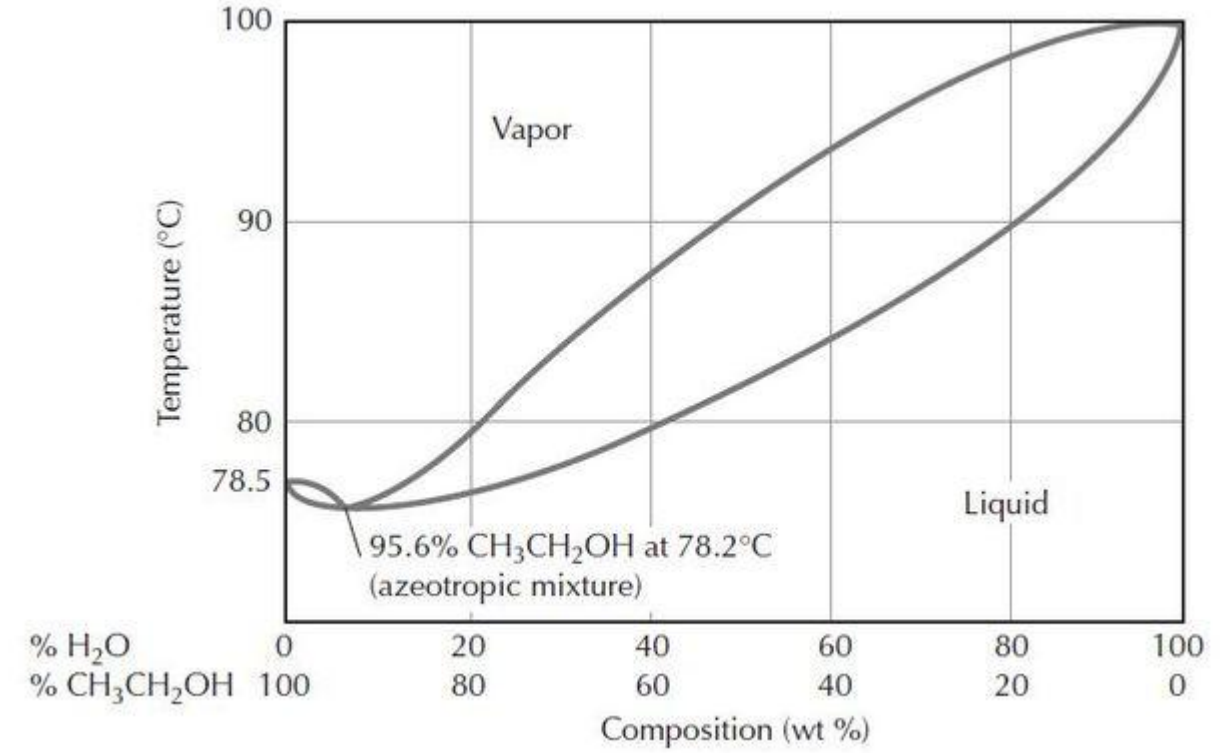
Distillation Theory




Thermometer adapter
Water out
Distilling head
Water in
Keck clip
Vacuum adapter
Keck clip
Fractionating column
Condenser
Open to air
Keck clip
Receiving flask
Distilling flask


70
65
60
55
50
45
40
35.1
30
Temperature (°C)
0.0
0.2
0.4
0.6
0.8
1.0
Mole fraction of hexane
V1
L1
V2
L2
V3
L3
V4
L4
V5
L5





Imagine you have a big stack of differently colored marbles. For whatever reason, you want to sort your marbles into different piles based on their color. So you begin to go though and pick out the colors one by one. If you have a small number of marbles this won't take long. But now imagine your marbles are about a billionth of a meter in diameter and there are so many of them it would make Avogadro, er, I mean your head spin. Well, it wouldn't be very practical to go

through with a very small tweezers, picking out all the marbles that are the same color. Indeed, color loses its meaning at those scales anyway. So we have to use some other method to sort them, hopefully a method that doesn't involve much manual sorting.

I'll return to the realm of not insulting your intelligence now.

Distillation is a method of separating two or more liquids by taking advantage of their differences in vapor pressure. Vapor pressure is the pressure exerted by the gas above a compound. All compounds have vapor pressure, even solids. Granted, the vapor pressure of steel is much less than that of, say, water. Given this fact, it would be fairly easy to separate water from steel, yes? Vapor pressure is exerted by ice. This means ice can evaporate, and in fact this is what causes freezer burn. But what if we have two liquids that have relatively similar vapor pressures (but still different) and we can't just use some sort of filter to separate them?

Let's say we have two liquids A and B. A and B have a vapor pressure at room temperature of 22Torr and 40Torr, respectively (Torr is a unit of pressure). Let's say we have exactly the same amounts of A and B in a container. This means that the composition of the liquid is 50%A and 50%B, but the vapor ABOVE the liquid has a composition of 22/(22+40)=35%A and 40/(22+40)=65%B. There is significantly more of compound B than compound A in the vapor! By the way, this is probably a horrendous oversimplification of the proportions, and I COULD flip though my O-chem book to find the correct relation, but I'm sure you get the general idea. Now, if we can collect this vapor and turn it into a liquid, we would have a liquid of composition 35%A and 65%B. We would be one step closer to separating our compounds.

In fact, we CAN collect the vapor and turn it into a liquid by cooling the vapor down so that it condenses. And as luck would have it, as we remove vapor, it is replenished constantly by the liquid below. Unfortunately, this process will be EXTREMELY slow because the vapor pressures are so low and very little vapor can escape from the liquid in the container in a given amount of time. It could take days or weeks to separate them. If only there was a way to raise the vapor pressure... Well there is. And we do that by adding energy, in the form of heat, to the system. By adding heat, we can raise the total vapor pressure within the container to exactly 760Torr, but no further. This is because 760Torr is the pressure of the Earth's atmosphere, and it is at this point that the liquid in the container begins to boil.

Now we can collect the vapor above the liquid and it will be replenished VERY quickly. The boiling will actually push the vapor out of the container, and as long as we channel the vapor through something cold, thereby reducing the vapor pressure once again, we can condense it and collect it as a liquid with a high concentration of compound B.

This is what a distillation apparatus does, and one distillation step is referred to as a "simple distillation". A mixture of liquids is placed in a pot that is heated to boiling. The temperature of the vapor is measured by a thermometer at the top of a vapor column, as an indication of relative purity. Condensate (distillate) is usually collected over a certain temperature range, which is indicative of the purity of the result. The vapor travels through a condenser that cools the vapor, returning it to a liquid state that is a different composition from the starting liquid.

If we do this over and over again, we'll eventually get a liquid that is nearly pure B, and almost no A. Note that purification actually takes many repetitions of distillation. Well, that's kind of a pain. What if we want to completely purify something very quickly?

That's where fractional distillation comes in. A fractional distillation column is a device wherein MANY distillations occur in ONE step. The fractional column is a long tube that is packed with a material high in surface area but low in volume. Glass beads, chambers separated by plates, and various shredded materials work well as packing. As vapor travels up the column, a temperature gradient is created (higher temp on bottom, lower temp on top). This causes vapor to condense on the packing as it rises. The condensed material is higher in purity than the starting material. Then more vapor travels up the column, heating this condensed liquid to its new boiling point and vaporizing it, with the vapor being one step higher in purity than the last step. As the composition skews further toward B, the boiling point drops, reinforcing the temperature gradient as the material travels up the column. This occurs many times as vapor travels up the column, with the

lower vapor pressure liquid separating out and dripping back down the column and flowing back to the original container. Fractional columns are often referred to as reflux tubes for this reason.

The use of a perfect fractionating column would result in very sharp jumps in temperature readout on the thermometer. As each pure compound is exhausted in the container and the next lowest boiling compound climbs the column, the temperature will rise quickly, indicating the change in compound.

Performing a distillation using a fractional column is referred to as "fractional distillation" and results in a highly purified liquid.

This project allows for the use of both types of distillation, since many raw products to be distilled contain organic solids that can contaminate the packing of a fractional column, and MUST be simply distilled first to remove these impurities.

Part List


PROPANE FUEL
COLEMAN
LEAD FREE
SOLDER PASTE


23.9
digi-thermo

I've included the prices of the things I had to buy, but I had most of the tools laying around already. Plus, all these things can be found at a hardware store.

For this project you will need:

Tools:
Small propane tank with torch attachment
3/4" or larger diameter copper pipe cutter $7
Spool of copper solder
Soldering flux with brush
3/4" and 1/2" inside and outside joint brushes.
120 grit sandpaper
A vice, or something to hold parts while you're soldering
Teflon tape
Small metal file
A drill (preferably a drill press but any will do)
1/4" Drill bit.
3/4" Hole saw

Materials:
Accurate thermometer, preferably digital with a metal probe.
1/2" Rubber or cork stopper.
~1' 3/4" Copper pipe $4
~3' 1/2" Copper pipe $6
Four1/2" Male adapter
Two 1/2" Female adapter
Two 1/2" Tee
Two 3/4"x1/2" Adapter
One 1/2" 45
Two 1/2" Coupling
~3" ~1/4" Outer diameter Refrigeration tube
~15' 3/16" Inner diameter flexible plastic hose $0.20/ft
1ea Copper pot scrubber $1.50

You will also need some method of getting water from your kitchen sink to go into the 3/16" plastic hose. This really depends on your sink so it'll take some thought on your part. I found that my kitchen faucet has a non-standard end thread so I was forced to connect directly to the wall outlet. I used:
1 3/8"x3/8" sink supply line (the size will depend on the valve you have)
1 3/8" male thread to 1/4" pex adapter

Ah, AND you will need some kind of distillation pot. This can be anything that seals, can handle high temperatures, and that you can install a 1/2" Female adapter into. I used an old 1 gallon aluminum pressure cooker I found at Goodwill for $5.

Preparation

So. You have a pile of raw materials sitting in front of you, patiently waiting for you to turn them into something amazing. Get to it.

Cut the pipe to length. You will need the following sections:
Two 1" long 1/4" refrigeration tube.
One 18" long 1/2" pipe.
One 12" long 1/2" pipe.
One 6" long 1/2" pipe.
Two 3/4" long 1/2" pipe.
One 12" long 3/4" pipe.

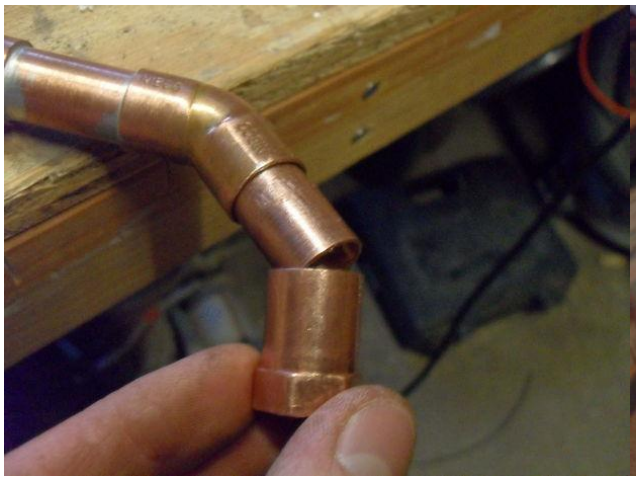
You need to put a slight bend at one end of the 18" long 1/2" pipe. This is tricky, and it's what the 1/2" couplings are for. Use the metal file to file away the pipe stops on the inside of one of the couplings so it can slide freely over the 1/2" pipe. Place the slide coupling about 3" from the end of the pipe. Place the other coupling on the end of the pipe. Now find some way of bending the pipe gradually WITHOUT KINKING IT. This is hard to do. Kinking it will result in liquid build-up behind this raised section. It's not the end of the world, but it represents a loss of distillate, which is bad for efficiency. Denting the pipe first with a brass hammer where you want it to bend helps. The couplings help prevent the circular diameter from distorting at those points so you won't have problems joining things to those points later.

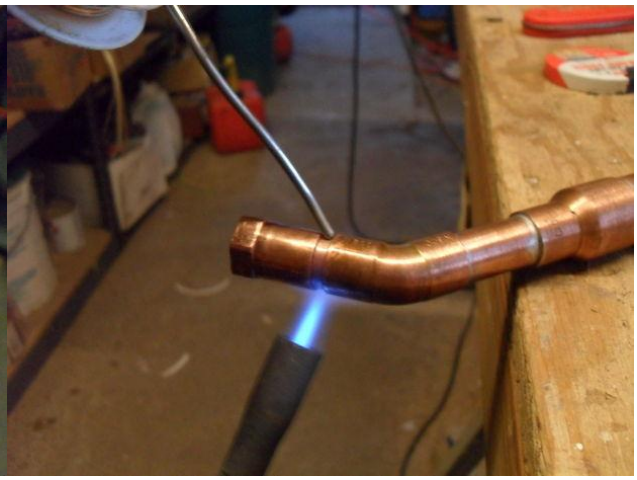
Alternatively, you could use the easily bendable 1/2" pipe that comes in rolls that is made from soft copper, but this may make the whole apparatus weaker in the end.

Using the file again, file away the stops on the 3/4"x1/2" adapter so it can slide freely over the 1/2" pipe.

Using the drill, drill two holes in the 3/4" pipe section, 1" from each end, on the same side of the pipe. The 1/4" refer tube needs to fit into this hole snugly. A small pilot hole helps overcome the frustration of drilling into a curved surface.

Proper Soldering Technique





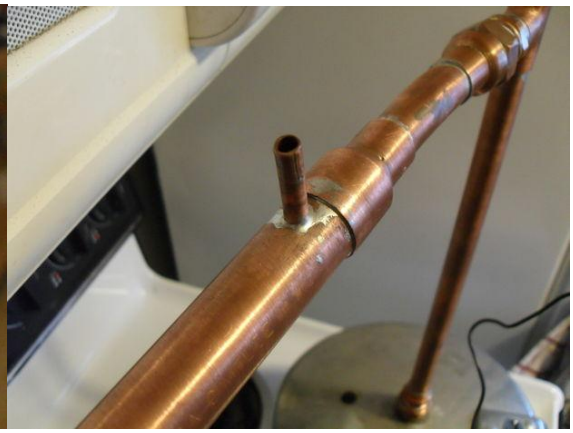
Now everything is ready to solder together! If you've done your prep work properly, this step is easily the most fun.

If you've never soldered copper before, I suggest starting with the columns that will end up vertical, since these don't involve non-standard joints. Use the joint brushes to thoroughly clean the areas to be joined. The copper should be bright and lustrous before you solder. Use the flux brush to apply flux to all surfaces you want to bind together with solder. This means the inside of the fitting AND the outside of the pipe. Then place the pipe inside the fitting, make sure it goes in all the way. Place the part in a vice (wrap it in a towel to avoid marking the beautiful copper) or on the edge of a table. Remember, this copper is about to get VERY HOT.

I've found that trying to flux and solder joints that are far from each other in one soldering run is a bad idea. When flux is heated and not soldered it loses is flux-iness. The joint will need to be re-fluxed or the solder won't flow correctly. If joints are literally right next to each other this isn't a problem.

Fire up the torch and adjust the knob so that the bright blue cone of flame within the outer flame is about an inch long. Touch the tip of this inner flame to the joint, preferably near the lower surface (heat rises). Touch the solder to the OPPOSITE SIDE OF THE JOINT from the flame. The ENTIRE JOINT must be hot enough to melt the solder for the solder to flow, so this prevents making a bad joint. Slowly melt the solder into the joint until one drop of solder falls from beneath the joint. This ensures you have placed enough solder. If you want a clean-looking joint (no solder blobs), quickly (before the solder solidifies) brush the exterior of the joint with the flux brush AWAY FROM YOUR FACE. This will remove the majority of the exterior solder drippage.

Solder parts



This step is difficult to describe in words. I think it would be best for you to examine the pictures and figure this out for yourself. Most connections are self-explanatory, with a few exceptions.

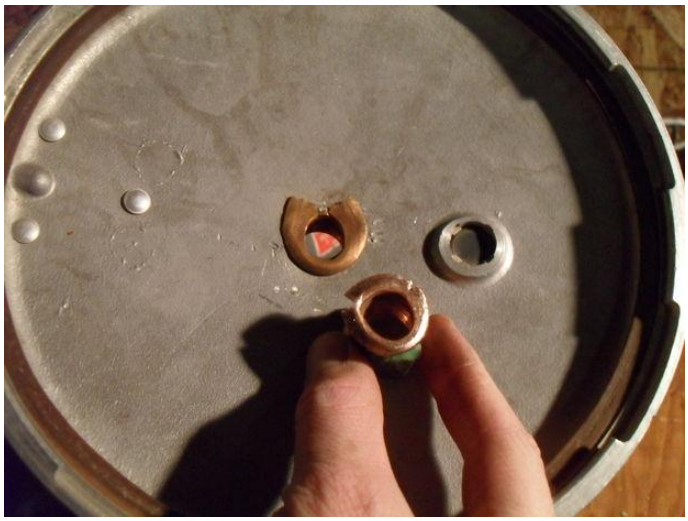
The condenser is the most complicated bit. The 18" long 1/2" pipe resides on the INSIDE of the 3/4" pipe. The 1/2" pipe is one continuous piece with the 3/4" pipe sheathed around it concentrically and held in place by the 3/4"x1/2" adapters. There is very little space between the two pipe walls by design. It is ESSENTIAL that water be able to easily flow through this outer space between the two pipe walls. This outer sheath of flowing cooling fluid is what allows the whole apparatus to be so compact. Problems arise in assembly because the water is introduced to the chamber by the 1/4" copper tubes. If the 1/4" drilling burr or the 1/4" tube itself protrude too far into the chamber, it will restrict the flow of cooling water by contacting the outer surface of the 1/2" pipe. Use the file to reduce the size of the burr (you want a little bit there to help the soldering process) and make sure when you solder the tube in place it is just barely going past the inside wall of the 3/4" pipe.

Solder the 1/4" tubes in place FIRST so you can see what you're doing. Then clean (with sandpaper on the 1/2" pipe), flux and solder the two joints made by the 3/4"x1/2" adapter NEAREST to the the bend in the 1/2" pipe. Fit the other adapter onto the opposite end but do not flux it. The second adapter is just there to keep the pipes aligned for now. ALIGN the 1/4" tubes so that they will point UP (in-line and away from the 1/2" bend). Solder the joints near the bend in the 1/2" pipe. The 3/4" and 1/2" pipes are now bound concentrically by one soldered adapter. Now flux and solder the second adapter.

When the assembly cools, make sure the cooling chamber is sealed except for the 1/4" tubes by blocking one with your finger and trying to suck air out of the other. Then try to blow air though the chamber. If you've got a good seal and good air flow then congratulations, the rest of this is a piece of cake!

So you're done soldering and making everything functional. Good for you. Now the question is, are you barbaric enough to let this piece of art go unpolished? Sand it!

Distillation Pot



Somehow. Somehow you will need to find a way to install a 1/2" female adapter into the top of the distillation pot. What worked for me may not work for you. Here's what I did:

I drilled a hole in the top of my pressure cooker with a 3/4" hole saw, where the little pressure release nub is. I had to remove the nub first so I could center the drill in the resulting hole. Then I tried to solder the back end of the female adapter to the top of the pressure cooker. Apparently copper solder doesn't like to bond to aluminum. I thought about making some kind of escutcheon that I could solder to the female adapter on the inside of the pressure cooker. I gave up on that idea. I tried to use a big metal spike and a hammer to widen the back of the female adapter and that didn't work, I just ended up with a big spike stuck in there. Then I got frustrated so I beat the crap out of the female adapter with a big mallet and it flattened it. That gave me an idea.

I got a new female adapter and put it though the hole in the lid (threads facing the outside of the lid) and rested the threaded end of the adapter on the anvil of my vice. Then I placed the ball end of a ball pean hammer on the soldering part of the adapter. Then I beat the ball pean hammer with the big mallet. This deformed the back end of the adapter so it had a lip. Then I beat the crap out of the adapter with the mallet directly and flattened the lip against the lid of the pressure cooker. The thing works beautifully.

Fractionating Colum

This is kind of important. There are some nasty chemicals on the surface of the copper after soldering. You probably don't want those in your ethanol. Dish detergent and warm water do the trick. A long thin brush helps, the kind they make for test tubes. But whatever works. This is especially important for the tube that will become the fractionating column, since that's supposed to be pure output.

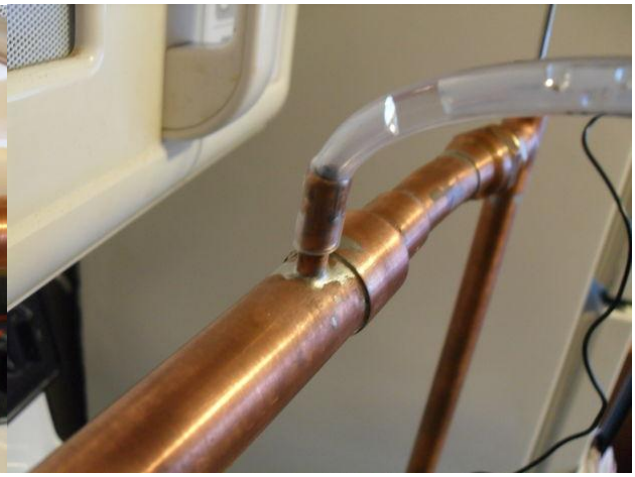
Right now your fractionating column is a lot of column and not a lot of fractionating. You need to pack it.

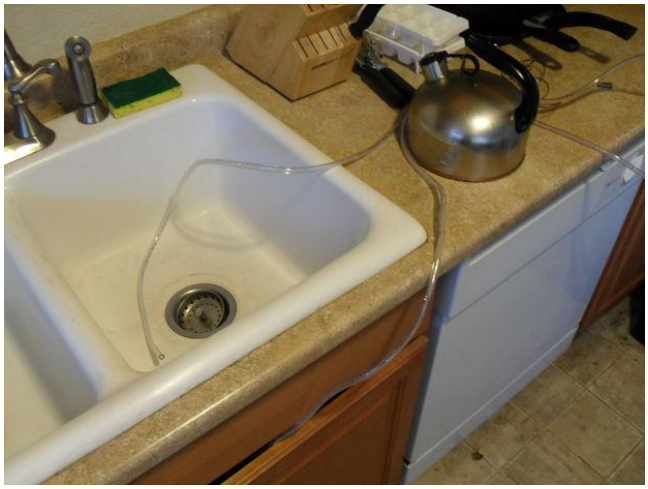
Go to the grocery store. Go down the cleaning supplies aisle. Go to the dish scrubbing section. Look for the old fashioned metal mesh dish scrubbers. There are three kinds: Stainless steel, galvanized steel, and copper. Don't get the galvanized one. Zinc is good for you in small amounts, but I don't know what the solubility of zinc is in an environment like the one you're making. Go for copper.

Remove the wire/staple that holds the scrubber together and unravel it. Now get a wire/cord and feed it down your column and tie it to the end of the unraveled scrubber. Pull the scrubber though the column. Use a scissors and a needle nose pliers to trim the scrubber and pull it into position.

The scrubber should reach the very bottom of the column, and stop short of the first opening of the Tee. Viola, you have a fractionating column.

Hook It All Up






Magic Chef

So now you have:
Distillation Pot.
Condenser.
Simple Column.
Fractionating Column.
Long plastic tube.
Kitchen faucet connection.

Assemble the pot, condenser and one of the columns on your kitchen stove. Connect the plastic tube to your kitchen faucet (remember, YOU have to figure this one out). Find the length of tube you need to go from the faucet to the condenser with some slack. Cut the tube. Put the end of the plastic tube coming from the sink over the 1/4" copper tube at the BOTTOM of the condenser. Run the other section of plastic tube from the TOP of the condenser to your sink drain. When you turn on the water, you should get flow from the faucet to the condenser, then back to the sink. You are now water cooled.

The condenser is a little heavy to be sitting way up there, floating over your stove, attached to nothing but the distillation pot. Get some wire/cord and tie it to something so it doesn't nose dive in the middle of a distillation.

Step 3: Distilling process:

I will light the stove and put the distiller apparatus on top.

Turn on the cold water, so the steam coming from the distiller is being transformed into liquid when it pass through the cold copper tube.

You can see that this actually burn from the first pass of the distilling process.

You can measure the alcohol level and if it's not high enough, you can run the distilling process again, instead of apple mixture, you put back the resulted alcohol and let it distillate again.

You need to keep testing the alcohol level from the exit pipe, if you keep it too long on the stove, water will start dripping in and you don't want that.

The reason that the alcohol comes first, is because it's boiling at a lower temperature than water, so it will transform to steam sooner. Eventually, water will start boiling too after no alcohol is left.

Now I am going to run the alcohol one more pass to obtain a high quality ethanol.

After the last step is completed, we are ready now to test this out.

Step 4: Make the mixture and test it:

In order to run the regular gas engines with ethanol, we need to add in the mixture 20% of gasoline, so it will be 80% pure alcohol and 20% of gasoline.

This is required for the engines to lubricate, the ethanol is much dryer than gasoline, if the engine is not lubricated adequately, and you may risk breaking it, so make sure that you are using the right mixture for your engine to run smoothly.

My car runs on diesel, so I will test the ethanol on an electricity generator which runs on regular gas.

> We will do the burning test again, so you can see that our final product actually burn very well.

> Now I am going to mix the regular gasoline with ethanol and start this generator.

Now I am going to mix the regular gasoline with ethanol and start this generator. I will plug our lights which are consuming 1000W each.

I hope that you enjoyed our guide and that you have all the information you need to start producing your own ethanol. Make sure that you are doing this legally though, because it's a free application in the first place and you have no reason to go against the law just from commodity