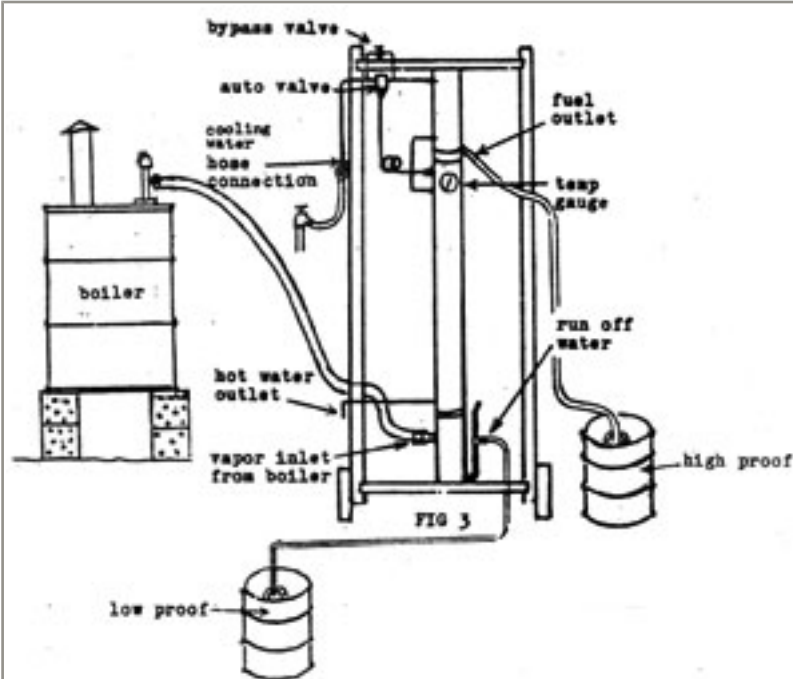


Still Safety

Introduction

Murphy's Law says that if anything can go wrong, it will. In terms of running a still, this means you must pay attention, and follow the following safety warnings, so that you make a still which will not blow up in your face.



Alcohol as a liquid is not dangerous (unless taken internally) but **ALCOHOL IN A VAPOR CAN EXPLODE!** It would be useless as a fuel if this were not true. That said, petrol (gasoline) is far more dangerous, and yet we use it every day, except generally, not around open fire.

This still is really a lot safer than most batch stills,

A: because the boiler can be set up at a distance from the still. and

B: because it operates for all practical reasons, pretty much at atmospheric pressure. no internal pressure is allowed to build up. This part is detailed in the next section, on building the boiler.

A pot still is far more dangerous with the reflux column up there on top of the boiler, where the spillage and vapors are directly above open flame or an electrical heating element.

Alcohol does not explode like gasoline. Gas vapors go off with a bang. Alcohol burns more slowly, so when it lights, it goes off with more of a whoosh which may ignite something else. So just keep flammable stuff at a distance.

This still is very small. Don't let the size fool you. It can produce as little as a quart an hour, or it can get up to several gallons an hour. This is because it operates on vapors from a boiler containing fermented brew. The distilling process actually begins at the boiler. The boiler can be anything from a small pressure cooker to a 1000 gallon boiler.

Distilling is a process by which the alcohol is driven out of the beer by heat. When two liquids are mixed, their boiling point changes to a point between the boiling points of the two liquids. Just where this new boiling point is in terms of exact degrees depends on the concentration of the two components of the liquid.

Vapors mixed together act independently.

Because we are starting with a solution containing less than 15% alcohol, a great deal of water will be vaporized as we heat the liquid.

The above drawing shows the boiler as a 50-gallon drum standing on end on concrete blocks. This is easy to set up, but is not ideal. It is far better to lay the barrel on its side, as this allows for faster and more efficient heating as the flames warm more of the barrel's surface. This requires driving stakes next to the outside of the blocks so they don't roll outwards due to the weight of the barrel.

Also, the safety release valve is shown at the top of the barrel. This valve is set for releasing steam if it gets above 2 psi. Text at the right tells you how to make one.

The boiler should present the largest liquid surface area possible. Vapor comes out of the liquid only at the surface, so the more surface area, the greater the opportunity for the vapor to leave.

If you are using a 50 gallon oil drum (I like to find a used vegetable oil drum, as there is no smell of petroleum), use it in a horizontal support rather than in a vertical position. This way, there is also more area on which to apply the heat, making a more efficient use of your heat source. For example, with a 200 liter oil drum. If heat is applied to the end of the drum while it stands vertically, the vaporizing surface would be the diameter of the drum. If the drum were lying on its side, the heated surface and the vaporizing surface would be considerably greater. The boiler should be vapor and liquid tight and able to withstand heat and pressure.

The distilling process begins at the boiler and the plumbing from the boiler to the still becomes the first stage of the still. If the piping from the boiler is not insulated, much of the water will condense and run back into the boiler or out through the runoff outlet at the bottom of the column. A slight downward slant from the boiler to the column will prevent the water from draining back to the boiler. This simple plumbing trick will extend the capacity of the still greatly.

REMEMBER: All the still is doing is cleaning the water out of the vapors before condensing them. The

higher the proof we want, the more cleaning we want. As soon as the vapors come out of the boiler, any slight cooling will strip out a portion of the vapors.

WARNING: Just as a covered pot will boil over when cooking rice or pasta, this can be a much bigger danger when heating such a big container. The main thing is, never have a completely closed container. While we don't want an open vent like the little hole on many cook-pot lids, as this would release lots of precious alcohol, we do want to blow off steam if it gets above 2 or 3 pounds pressure. The cheap and easy way to do this is to put a tin can upside down over a pipe fitting at the highest point of the barrel, with a 1 kg. rock to hold it down. I use a Tee fitting to direct the steam to the still via the side fitting, with a pipe nipple and homemade steam release valve on the top. This is safer than buying a steam release valve which is probably set too high to be safe. In the drawing to the left, you can see the safety valve just above where the hose comes off the barrel.

DOUBLER

The doubler is the bottom section of the drawing and where the vapors first come into the still. Here we create a pool of liquid from the stripping above and make the incoming vapors pass through it. This does several things.

1. The vapor heats the pool. In heating the pool the vapor will be cooled and a considerable amount of the water will condense. The reason it is called a doubler is because it was found that just about half the water condenses out every time it passes through one of these pools.
2. The heated pool will be above the boiling point of alcohol so that any alcohol falling from above will be reheated and go back up.
3. This pool will keep any solids that might have reached this point in suspension so that they will flow out in the runoff. This is a very important part of the still, even though it isn't difficult to build. In order to keep the pressure that is built up as the vapor passes through the marbles from forcing the pool out, the pool should be at least seven inches deep. The depth of the pool is set by the trap made by the runoff line.

MARBLE STRIPPER

Most stills will have a vapour stripper section, which may be plates or marbles. The Charles 803 Still combines the two types. There is a plate at the bottom and one at the top of this section with many holes in them. These holes should be at least 3/16 inches in diameter so that the liquid going down will not close the holes and stop the vapors from going up. They should be small enough that the stripper material does not fall through. The plate at the bottom supports the stripper material and the top one distributes the downward flow more evenly.

The first vapors entering the bottom of the still at the doubler will encounter the cooling pool, condensing some of the alcohol, lowering the boiling point of the pool. A 5/8" pipe runs through the stripping

material from above the vapor inlet to below the stripper coil inlet to allow some of the vapors to rise and cool quickly and replenish the pool before the boiling point is lowered to below the temperature of the incoming vapors, causing the pool to boil out.

You have just learned the principle behind the big steam columns. They supply steam at the bottom of the column and beer at the top. The plates inside work just like the marbles and the up and down flow begins. This type of still uses live steam to heat up the stripper, which also boils the beer. Either by controlling the amount of steam entering or the rate the beer is pumped into the column the proof is set. Because heat must be transferred from heat source to water to brew, and because the steam column adds water vapor which must then be condensed, steam columns are large and not very heat efficient.

CONTROL SECTION

This section simply puts a distance between the top of the stripper coil and the condenser to keep the two from affecting each other, and allows us to get some idea of what is happening inside the still. We need some reference temperature so that we can set the proof of the alcohol coming from the condenser.

The middle of the control section will give us a reference temperature. Let us stop for a minute and see what this reference temperature tells us. First we know that pure alcohol at sea level will boil at 173 degrees F. We don't want the temperature at our reference point below this or we will be condensing much of the alcohol. In order to distill a high proof alcohol the temperature should be as low as possible. The automatic valve will control this accurately. Exact temperature depends on altitude and a variety of other factors. The flow of water in the condenser coil needs to be no greater than sufficient to cool the liquid to 100 degrees F. This flow will be determined by the amount of vapor to be condensed and the amount of water in those vapors, which is determined by the temperature of the vapor going in. The flow of water through the stripper will be determined by the proof we want. The more vapor going through the still, the more water needs to flow through the stripper to keep the temperature of this section constant. The water going into the stripper should be the water coming out of the condenser. This water is already warmed somewhat, so it is less likely to overstrip or condense alcohol vapor. The water should enter at the top and come out the bottom of the stripper coils. The water coming out the stripper will be at very high temperatures. It can be used as a heat source for the distilling room, another room or part of the alcohol production process.

THE STILL IN OPERATION.

With a thermometer in the liquid area of the boiler we can watch the temperature rise in the boiler. At some temperature above 173 degrees F, the pipe between the boiler and the still will begin to heat up. The exact temperature at which this happens will depend on the concentration of alcohol in the brew. A low boiling point indicates a high concentration of alcohol. You can follow the vapors by feeling the pipe and still as they warm up.
Remember - The still starts at the boiler and the

vapors are being cleaned as they travel.

Soon the temperature in the control section will

start to rise. When this occurs start a cooling flow of water. If you are controlling the water flow manually, let the temperature rise to around 190 degrees F and hold it there to start with. Take a proof reading every 30 seconds until the proof starts to level off.

Once it has leveled off, start more water flowing

through the coils. The less vapor flowing through the still, the smaller the change and the slower the reaction should be. Be sure you allow time for the change to take place and the proof to level off.

Record the proof and temperature at each test so you can go to that temperature for that proof. If you have an automatic valve, turn it to the lowest temperature setting. When the control section temperature stabilizes, slowly turn the valve to a higher temperature until alcohol begins coming out. Let the still stabilize here and check the proof, raise the temperature slightly, stabilize and check the proof and so on until you reach the highest temperature your valve will allow, or the lowest proof you wish to distill. Once you are familiar with the valve, you may set it quickly to get whatever proof you like and it will consistently get that proof.

Dont be surprised if the alcohol starts coming out before you turn the water on. The vapors will condense on the condenser coils as they warm the condenser.

REMEMBER:

You are not applying heat in the still. The control temperature is the result of vapor flow. If you dont have any vapor flow, the temperature will not be very high. The more alcohol in the beer, the sooner the vapor begins to flow. If nothing but water ever comes out of the still, there was no alcohol in the brew. Soon after you start distilling, there will be some flow out of the runoff outlet. This will mean that the pool is full and the still is nearly stabilized. Once the pool is full and you have adjusted the temperature to the proof you want, alcohol flow will increase. The up and down flow is established and the pool is flashing the alcohol that reached it back up to the stripper. As long as the heat is being applied to the boiler at an even rate, the vapor is removing all the heat that is being put in.

REMEMBER: The brew is losing alcohol. The smaller the batch or the more heat being applied, the faster this happens. As the alcohol percentage falls, the temperature in the boiler will begin to rise. This is because the boiling point of the mixture is approaching that of water. The rise in temperature will be seen in the still also, so little by little more water will have to be sent through the stripper to hold that temperature steady.

Watch the boiler temperature closely and record these temperatures and the length of time it takes this rise to occur.

The operation of this still is such that the heaviest

flow will be at the beginning and slowly taper off until the alcohol flow stops altogether. Check the proof as it gets near the end.

If it begins to fall off increase the stripper water. You will notice more and more flow out of the runoff. When the alcohol all but stops, check the boiler temperature. This will be the temperature at which your still will have most of the alcohol out of the brew. This is when the heat should be shut off. If the amount of alcohol coming out of the still could not keep the fire going you are putting more energy into the operation than you are getting out.

The liquid left in the boiler contains the acid you added earlier to lower the pH of your brew. This water may be cooled, the solids settled out and fed to hogs, poultry or fish and the remaining liquid put in the fermentation vat as the second half of the water to cool the brew before adding the second enzyme.

RUNOFF

There will always be some alcohol in the runoff. Although the quantity may be slight it is a good idea to rerun the runoff. It is much cleaner than the original brew and will clean out your boiler and the plumbing on the way to the columns.

CORRECTION AND ADJUSTMENTS

The first thing to be taken care of is any liquid or vapor leaks from the still. Vapor loss means loss of alcohol. This can be checked before operation by sealing off all but one opening in the still. Blow air into that opening. Any air leak would be a potential vapor leak. Seal these up.

If little or no alcohol came out and the temperature in the boiler slowly rose to the boiling point of water (212 degrees F) the problem is probably not with the system, but with the fermenting. Be sure you check the runoff. There may not have been enough heat to get the alcohol to the top of the still. With too small a heat supply this could happen. The still is designed the size it is so that you can use heat sources that are normally found on the farm to power it. It can be run at minimum capacity from the burner of a gas or electric stove. This will produce 6,000 to 10,000 BTU/hour of heat.

The same problem could be caused by too great a heat loss. If you are operating the boiler outside in the winter just a little wind could cause too great a heat loss and all the alcohol could be in the runoff at a fairly high proof or could have run back into the boiler. The boiler and still should both be inside a building.

TOO HIGH AN OPERATING TEMPERATURE

If, the control temperature is much above 173 degrees F when the proof of the product has peaked out (should be above 190 proof), we should make some corrections. This is caused by too much back-pressure in the boiler. Unless your pool is very deep, this would be the last thing to change. Within reason, the deeper the pool the lower the proof of the runoff. Too great a distance between the boiler and the still with too small a pipe is the most likely cause of the problem. The easiest way to maintain the low pressure required (5 lb.) and at the same time provide a blowoff valve for your boiler is to come out of

the boiler with a large pipe. This pipe should be 1-1/2 to 3 inches depending on the size of the boiler. Run this pipe up and out the top of the building. Put a metal plate with a rubber ring under it on top of the pipe. Weight this cap until it weighs five pounds. A tractor exhaust rain cap with a rubber seal will work nicely. This provides a pressure release at a safe distance from workers and visitors who seem to inevitably gather around a still, and also provides some stripping action. The line to the still can be tapped off this pipe and will pick up vapors with a higher concentration of alcohol higher up the pipe.

Even inside the boiler condensation is taking place. Any piping to the still becomes a part of the distilling process. What this still is, then, is a controllable cleanup mechanism. This is why we say dont underestimate the amount it can distill. It is also why we cannot say what the hourly capacity will be until the entire system is built. The more stripping that is done before the vapors get to the still the less work the still has to do. Once we get the still to produce the proof we want the capacity can easily be increased by working with the system ahead of it. For example, we could take the water from the stripper coils and run it through coils wrapped around the big pressure release pipe between the boiler and line to the still. This water has been heated in the stripper coils to only slightly below the temperature of the vapors leaving the boiler. It would absorb a tiny bit more heat causing stripping to take place in the vertical pipe but not condensing all the vapors or cooling them to the point that the still would not work.

REMEMBER: What you want is a slowly decreasing temperature from the boiler to the condenser of the still. This is the key to the whole system. As long as you do not shock the vapor with too sudden a temperature change, the water vapor will gradually fall out, Any alcohol that may condense along with the water will have a chance to revaporize as it runs back to the warmer part of the still. If you understand all of the principles, you should now be able to build a distilling system with a capacity of many gallons per hour. "Start out small and grow as you get the feel of what is happening.