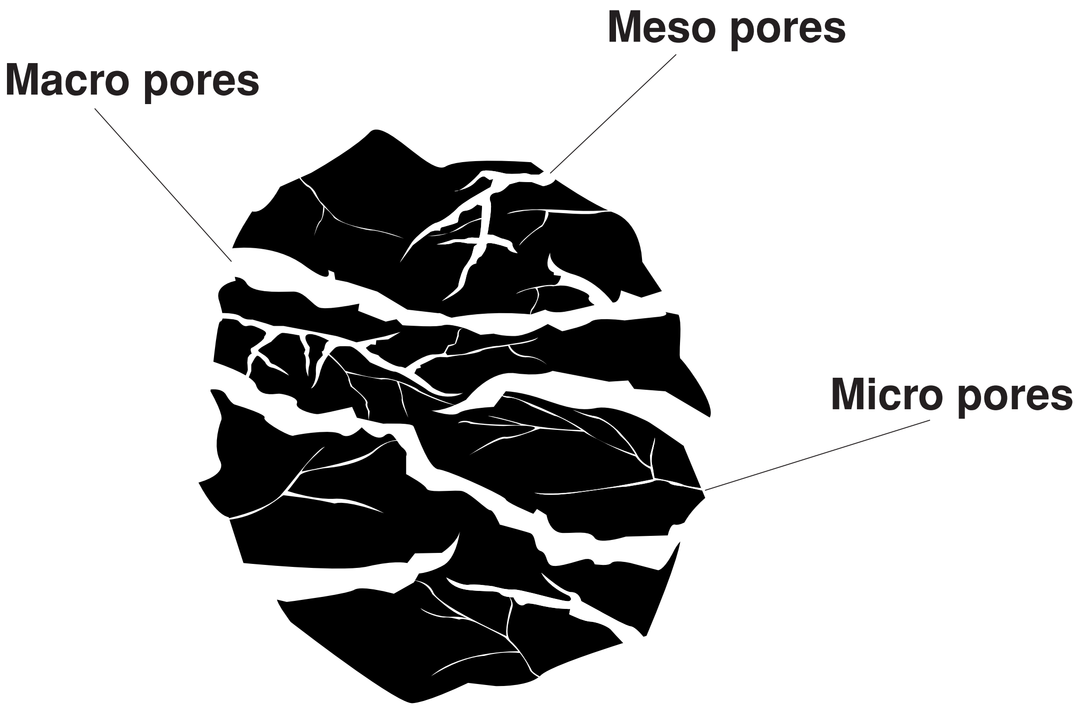
Activated carbon for purification of alcohol

- and some useful distillation tips -



by Gert Strand

CONTENTS

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Internet publishing: Gert Strand, Malmoe, Sweden
Set with: Times and Helvetica
Drawings: Sam Persson and Armin Mededovic, Malmoe, Sweden
Printed by: Gert Strand, Malmoe, Sweden, 2001

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ACTIVATED CARBON
FOR
PURIFICATION OF ALCOHOL

What is activated carbon?

Activated carbon is the common term used for a group of absorbing substances of crystalline form, having large internal pore structures that make the carbon more absorbent. Activated carbon is manufactured according to the Ostreijkos patents of 1900 and 1902. Every year, approximately one hundred fifty thousand metric tons of pulverized activated carbon are manufactured, together with one hundred fifty thousand metric tons of granules and thirty thousand metric tons of pellets/rods. Many different materials can be activated (wood, plastic, stone and synthetic materials) without actually turning them into carbon, and one can still get the same effect.

Activated carbon is the most popular and the cheapest material used in purification of alcohol, and steam-activated carbon is derived from natural raw materials. Much of activated carbon is regenerated (cleaning/desorption) and is used hundreds, or even thousands, of times.

Carbon is made from a variety of raw materials that are heated and further treated. During this treatment, some parts turn to gas and leave pores behind. There are hundreds of varieties of carbon on the market, but only a few are suitable for the purification of alcohol. Some types of carbon make the alcohol worse than before filtering - the reason for this is explained further on in this document.

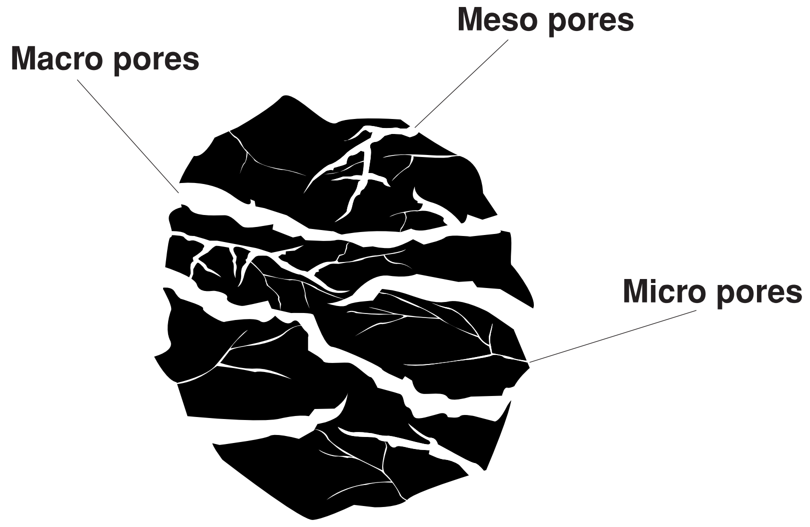
We often speak of the absorption surface of carbon, which can vary from 400-1600 sq. meter per gram, as a measure of the effectiveness of carbon. This is incorrect. The effectiveness of carbon depends on its ability to absorb a certain substance or substances, depending on the chemical and physical properties that carbon possesses. Activated carbon can be manufactured for different purposes.

What is important for the purification of alcohol as regards carbon pores:

1. The size of the pores in the carbon at the molecule level
2. What use one makes of the different carbon pores
3. How the different types of carbon pores are distributed

Carbon pores consist of:

1. Micro pores with a radius of less than 1 nm (small pores)



2. Meso pores with a radius of 1-25 nm (medium pores)
3. Macro pores with a radius larger than 25 nm (large pores)

Large pores are used for the **transport** of liquid **through** the carbon, and absorption occurs in the medium and small pores. Pores are formed during the manufacturing process, when the carbon is activated. The activation basically means that pores are created in a non-porous material by means of chemical reactions.

There are two different methods for this and they produce totally different pore structures:

1. Chemical activation
2. Activation by steam

The large macro pores act as **channels through the** carbon to the meso- and micro pores. Granular activated carbon always has macro pores, but in powdered activated carbon often no macro pores are to be found, since after grinding, the carbon consists of very small particles.

High and Low activated carbon

It has become standard practice to describe the level of activity in the carbon by the quantity of the carbon that has become gaseous and left behind empty spaces (the pores). Thus, a high activated carbon is the one with the most empty space. Such carbon has many meso pores and macro pores. It can have so many large meso pores (12-25 nm) and a large quantity of macro pores that it is not suitable for purification of alcohol. That a carbon is high activated is no guarantee of its quality or a measure of its effectiveness.

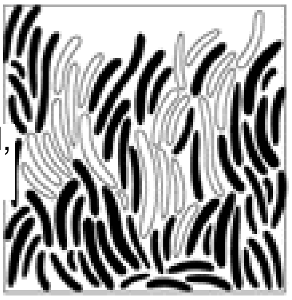
Pores in chemically activated carbon
Chemical activation is principally used for the activation of wood-based activated carbon and activated carbon made from stones, e.g., olive stones. This differs from steam activation in that carbonification and activation occur simultaneously. The raw material, usually wood chips, is mixed with an activating and dehydrating substance, usually phosphoric acid or zinc chloride. The activation takes place at a low temperature: 500°C is the norm, but sometimes it can go up to 800°C. The phosphoric acid causes the wood to swell and open its cellulose structure. During the activation, the phosphoric acid acts as a stabilizer and ensures that the carbon does not collapse again. The result is a very porous activated carbon full of phosphoric acid. This is later washed out and re-used in the next production.

As a result of the manufacturing process, no “chips” (crystalline plates) are to be found in this carbon. Instead, the carbon acquires a very open pore structure, which is ideal for the absorption of large molecules, e.g., in the clarification of liquids. As a rule, this carbon is ground down to powdered carbon.

Steam activated carbon
Steam activation is used throughout for the activation of carbon made from peat, coal, coconut shells, lignite, anthracite, or wood. First, the raw material is converted into carbon by heating. When coal is used as the raw material in steam activation, it always consists of small graphic-like plates, rather like potato crisps. The crisps are flat or a little curved, just like potato crisps, 0.35 nm thick and a few nm in width and length. The crisps are in disarray, as in a bag of potato crisps.

Water steam +130°C is then blown in at a coal temperature of approx. 1000°C. Some of the crisps ("in the bag") become gas and leave pores (empty space) behind. The form this takes depends largely on the raw material used. A hard material, like coconut shell, leaves almost nothing but micro pores, while a soft material like peat always get many meso pores as well.

Short activation period, many micro pores.



Medium activation period, many meso pores.

Long activation period, many large meso- and macro pores.

If we continue for a long period to blow in more steam, more and more crisps turn to gas and leave empty spaces (pores) behind. First we get micro pores. As the process continues, the surrounding crisps also turn to gas and the pores develop into meso pores. If we continue still further, we get a macro pore. This is usually already found in the structure of the raw material, so we do not need to make more. Wood, peat, and coconut shell have definite cellular structures that are maintained throughout the entire activation process.

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Re-formed activated carbon (compressed under high pressure) is also manufactured, often as small pellets a few mm long. Powdered charcoal is mixed with a binding agent and compressed under high pressure. Here, the macro pores are formed in the cracks between the powder particles. This type of activated carbon is not good for alcohol purification: the pellets are too big, the contact surface is too small, and the contact time is too short.

Ash content and after-treatment of activated carbon
The ash content of activated carbon is a measure of the mineral content (Ca, Mg, Si, Fe, salts, etc.) left in the carbon after the manufacturing process. We are only interested in the soluble (in water and alcohol) substances that remain. **We don't want to drink them,** and they often leave a deposit in the alcohol. Therefore, activated carbon used for purification of water, alcohol, and other foodstuffs is cleaned with acid, often followed by water, to get rid of most of these substances.

But - **all this carbon is meant to be used in carbon beds** that are **started up in the correct way.** This includes wetting and washing (or rinsing) the carbon. No carbon bed in an industrial filter is started unless the carbon has been **saturated for 24 hours** and thereafter **rinsed** for some hours. In this way **all the remaining soluble substances are washed out.**

The amateur distiller, who often pours dry carbon into a pipe and then directly filters the alcohol through it, releases the substances from the carbon and then drinks them. Carbon made from coconut shells usually leaves a white deposit in the alcohol. The carbon almost exclusively contains micro pores and is difficult to clean: hence the deposits. If you start up the carbon in the way recommended here, this problem will disappear by itself. In difficult cases an extra 10 liters of water is filtered through the carbon bed before alcohol is filtered.

Effectiveness of purification and pore size
Only a small part of the carbon's absorption surface is such that impurities can get stuck in them. The largest surface area is made up of micro pores, normally 90-98%. One to ten percent are meso pores and ca. 1% are macro pores. Many of the impurities we want to separate from the alcohol have molecules 2-10 nm in size, and are too large to be caught in the micro pores. **We also need meso pores**. Ideally, the pores in the carbon are slightly larger than the impurities that are to be caught in them. Smaller pores are not found, and there are few larger pores.

Pore structure depends on raw materials used
Activated carbon made from **peat** has both meso- and micro pores. In the manufacturing process it is possible to control the distribution of meso- and micro pores and get many meso pores for a **multipurpose** activated carbon. Even pulverized peat carbon contains meso pores.

Activated carbon made from mined **stone coal** also has both micro- and meso pores and also has a **multipurpose** character. Some of the most popular coal carbons on the market have 0.4-1.4 mm grains. An increasingly popular newcomer is coal carbon with smaller grains: 0.4-0.85 mm.

Activated carbon based on **lignite** has many meso pores 1-4 nm in size, along with larger meso pores with easy accessibility, also in pulverized form.

Activated carbon based on **coconut shell** has only micro pores throughout, less than 1 nm in size. If you purify alcohol (where many impurities are between 2-10 nm) with coconut carbon, you soon clog up the entrances to the micro pores, with the result that you cannot use the carbon to its fullest capacity. However, it can still be successful, since coconut carbon often has 2-3 times the ability of other carbons.

Chemically activated carbon is extremely porous, with many micro- and meso pores. Compared with steam-activated carbon, chemically activated carbon has a surface that **takes in less liquid and has a more negative charge.** This **reduces** the effect in the purification of alcohol.

Best pore combination for the purification of home-distilled alcohol
Several activated carbons are available for perfect purification on an industrial scale. This is because the alcohol is filtered from below upward and the contact time can be controlled by a **slow** flow-through speed. The amateur distiller filters downward from above, a process that is usually too fast for the carbon purification process.

So a simple peat carbon can be as good as - or even better than - a significantly better coal carbon. It depends more on how small one can get the granules. A coconut carbon of 0.4-0.85 mm, which is almost without meso pores, can do a fantastic job. The impurities are caught between the grains and in the approaches to the micro pores - **because the filtration is slow.** Likewise, a peat carbon (0.25-1 mm) can work better than a significantly “better” carbon.

Peat carbon usually has a surface of approx. 750 sq. meter / g, weighs half of, and can purify better than twice as much “good” carbon. This occurs because of **slow** filtering (longer contact time), a **large contact surface,** and also because there are **many meso pores** in peat carbon. On the other hand, it is not as good for regeneration in repeated use, as it is easily broken. Harder carbons, like **stone carbon, are better for regeneration.**

There is no obvious carbon for the amateur’s use. One can choose a carbon with 0.4-0.85 mm grain, or mix 2-3 varieties. The tried and tested mix is that of stone carbon and peat carbon. With Prestige activated stone carbon, 0.4-1.4 mm, the quality is consistent. It is a reliable carbon, but the grains are large, 0.4-1.4 mm, so it does not always have enough time to be 100% effective. Peat carbon has smaller grains and many meso pores, giving slow filtration. It is also popular to mix coal carbon 0.4-1.4 mm and a coal carbon that has smaller grains, 0.4-0.85 mm.

Lately, many people have started to use stone carbon only, 0.4-0.85 mm. As it is a coal carbon, it has both micro- and meso pores, and the small granules make this carbon preferable. In terms of quality, the Prestige activated carbons found at www.partyman.se are the best. Here one can choose between the leading products’ qualities. Prestige activated carbons are useful as they **set the standard** and can be used to **compare** and evaluate other brands. The first thing to check when a carbon does not work is its ability to purify alcohol. With a Prestige carbon one always knows it works.

Problems with quality
There are large numbers of quality problems with activated carbon. The most common problem is the deposit in the alcohol. This is typical of coconut carbon. One time it's fantastically good, the next time the carbon leaves a deposit. Usually this means that the manufacturer has not given the carbon a proper acid washing. If this is not done properly, the carbon leaves a deposit; next time there is no deposit, so the washing has been done correctly.

You must wash out the substances from the carbon remaining from the manufacturing process: they are not carbon, and have not turned to gas and left the carbon during the manufacturing process. When the carbon leaves a deposit (not to be confused with the chalky deposit from the "too hard" water in which the alcohol was sometimes diluted), it is these substances (the salts) that are deposited. They get mixed in with the alcohol and later begin to separate as white particles.

Another common problem is the poor sifting of small-grained carbon. The powder is not properly sifted away and the filtration stops. Similarly, there may be too few small granules, speeding up the filtration, thus the carbon does not manage complete absorption. The same happens if granules too large in size are chosen. For example, 1-3 mm granules will not work at all.

Another quality problem is that the sales person has no notion of what she/he is selling to you. They sometimes tell you that "this" is a wood carbon – when it's a peat carbon. The carbon is re-packaged and the label information is not consistent with the content. One brand can be bought in two types with exactly the same content information, one manufactured in Europe, the other in China. The European carbon is far superior, despite the fact that they should be exactly the same.

Worst of all are ignorant dealers, who think that **all** activated carbon can be used for purification of alcohol. This is **no**t the case. First and foremost it must be a pure (food grade) activated carbon for foodstuffs, like drinking water or alcohol. Instead they sell carbon meant for air or gas filtering. This type of carbon has not been rinsed after manufacture, and there are many undesirable substances in the alcohol, which then must be discarded. If the carbon is chemically activated, one gets phosphoric acid or other chemicals.

Some types of carbon are made from byproducts like oil, bone, animal carcasses and other material, which cannot be used for food-grade carbon. Many of these carbons give the alcohol a worse taste than before purification (often a gunpowder taste). It is a direct health hazard.

Does all home-distilled pure alcohol require purification with activated carbon?
Yes. Even if one makes equilibrated distillation, collects pure 95% body only, there will be traces from the fore shots and the head in the alcohol. Books and experts might tell you this is not so, but it is **easy** to prove: regenerate the carbon in an oven and smell the vapor.

Purification with activated carbon
Activated carbon as a means of purification of alcohol is a very effective natural product. It is also cheap, and the carbon can be recycled and used again. It is the world's best-known medium for purification of water and alcohol. The fantastic properties of activated carbon allow us to trap poisons, creosotes, heavy metals, insecticides, bad smells and tastes, chemical substances, fusel oils and impurities, or undesirable substances in both liquid and gases.

Activated carbon works when ordinary physical filtering (using a sieve, filter paper and filter pads, and sand) cannot separate a particular substance. Activated carbon works by absorbing impurities into its pores. Absorption happens through cooperation of the carbon's enormous adsorptive surface, including its weak **electrostatic charges** (known as Van der Waals forces, named after the scientist who studied them), together with the **distribution of pore sizes** (micro-, meso-, and macro pores), and the construction of the pores surfaces (called **cohesion forces**). The carbon pores become saturated with impurities, attaching even to the outside of the carbon.

What happens when carbon adsorbs impurities?
Absorption occurs when organic impurities are bound inside the carbon pores. This happens when the pores are marginally larger than the impurities (molecules) that they bind.

There are 2 kinds of absorption, physical and chemical
Physical absorption happens when the impurities are bound in the pores and on the surface of the carbon by means of Van der Waals electrostatic forces, making the carbon act as a magnet. The impurities on the outside of the carbon are loosely attached, like oversize molecules that have been trapped in the opening of smaller pores.

Chemical absorption is the union of impurities with other substances on the surface of the carbon pores. This is a powerful absorption. The chemical substances present on the pore surface depend on the raw material used, activation method, and after-treatment.

Three available forms of activated carbon
1. Pulverized carbon
2. Granulated carbon
3. Reformed (under high pressure) carbon, usually pellets

Purification ability depends on many things, including:
- Which carbon is used
- The surface of the carbon in sq. meters per gram
- Pore structure (distribution of micro-, meso- and macro pores)

The substances that will be absorbed depend on:

- The size of the molecules in the impurities (they must be smaller than the carbon pores)
- The density of the impurities
- The amount of impurities in the alcohol
- The boiling point of the impurities

The impurities must be small enough to fit in the carbon pores. An impurity with a higher boiling point is more easily absorbed, and adheres better than one with a lower boiling point. If the carbon becomes saturated, an impurity with a higher boiling point can eject a lighter impurity and take its place. This happens most easily on the carbon surface, where the impurities are loosely attached, but can even happen inside the carbon pores. This is why we **never** filter the same alcohol more than once through the pipe: the result would be worse.

Temperature

Room temperature works well, whereas purification in cold temperatures works less effectively, or not at all.

Purification methods

1. Using pulverized carbon, which is sludge in the alcohol
2. Filtering the alcohol through granulated activated carbon

Pulverized activated carbon

Pulverized activated carbon **is not 100% effective** in purification of alcohol. If you want a really pure alcohol, you must use a tube filled with granulated activated carbon. But it is helpful to pre-treat the alcohol with pulverized activated carbon before ordinary purification. It is done as follows:

1. Mix 4 grams pulverized carbon per liter of alcohol.
2. Pour straight into the alcohol.
3. Let it stand at least 24 hours.
   NOTE: During this time, the mixture should be shaken at least four times.
4. Let the mixture clear for 24 hours or more, during which time the sediment sinks to the bottom and the alcohol clears.
5. Now siphon off the alcohol: the sediment is filtered.
6. Filter the alcohol in the usual way in a pipe filled with granulated activated carbon. Since the alcohol is already somewhat purified, the granules can work more easily.

Granulated activated carbon
Granulated activated carbon is used in thick layers, usually between 1.5-2.5 meters where the filtering takes place **through the carbon**. Inside the carbon, the alcohol runs through **the macro pores** in the granules. The layer is constructed by filling a pipe with activated carbon. For easily purified liquids, like water, a layer of 5-10 cm should be enough. Alcohol normally needs 1.5 meters. It does not matter if the layer (the length of pipe used) is higher, but if it is too thin, then purification will not take place. The pipe **must be at least 38 mm** in diameter otherwise a **"wall effect"** will be created and the alcohol runs past the carbon along the wall, **without** being purified.

For the filtering to really take place in the carbon, **the pipe must be free from air.** This means that the purification must take place in one continuous flow. The pipe must not be allowed to run dry. The carbon **must** also **be saturated** so that the alcohol immediately runs **through** the carbon. Neither should any channels be allowed to form in the carbon filled in the pipe. This will happen if you pour dry carbon into the pipe and then in the alcohol. **Channels** are formed in the carbon, through which the alcohol can escape unpurified, as in the **film of air** between the carbon granules. The carbon bed must be **correctly started.**

When water or alcohol is filtered through carbon, the first thing to happen is that the soluble substances left in the pores from manufacturing are **dissolved.** These are the substances that have not become gas and evaporated, **and have not been rinsed out** after manufacturing. It would be too expensive to completely rid the carbon of the substances. **All industrial filters are started up despite this,** and the carbon is **rinsed through before use.** Everyone who works with activated carbon knows that these **substances are present** in the carbon.

The **substances (salts)** are easiest described as **soap-like.** When these substances are dissolved, the pH balance rises from 7 to nearly 10, and the carbon will not be as effective again until the pH balance has been restored to that of water or alcohol, approx. pH7 (neutral). Before the carbon is used for purification, **these substances must be washed or rinsed away:**

1. Before pouring the carbon into the pipe, mix the carbon (stirring vigorously) with 2-3 times as much hot or boiling water in a stainless steel saucepan.
2. Discard the surplus water and repeat the process 4-5 times, ensuring that all soluble substances are dissolved away from the carbon.
3. Leave to stand **for 24 hours, giving the carbon time to soak up more water.**
4. Again, pour in hot or boiling water, stir and discard the surplus water. Attach 2-3 filter papers to the pipe and **fill it with warm water.**
5. Pour the **saturated** carbon into the pipe in such a way that it **always** remains in the water and all air is driven out.
6. **Tap the pipe** to make sure the carbon is properly settled and packed (positioned).
7. Filter at **least 2-5 liters of water** through the pipe, and fill up with alcohol before the water has run through the funnel, making sure the pipe does **not** run dry. If you let the funnel run dry by mistake, filter another 4-5 liters of warm water to get rid of all the air, and continue with alcohol **before** the last of the water has left the funnel. In this way the carbon is **started** up and **no air** remains in the pipe. The **air film** between and inside granules **disappears.**
   Filtration must be **continuous;** the pipe must **not** be allowed to **run dry.** It is best to have a **large** funnel or container attached so that you don't have to keep filling all the time. It is all too easy to forget a filling and let air into the tube.
8. Lastly, pour a liter of water through the pipe to **get all the alcohol out.**

A filter bed of granulated activated carbon
Activated carbon with both micro- and meso pores is needed.

The tube can be filled with several kinds of activated carbon, mixed or separately in layers. It is very common to use one carbon only. Activated stone carbon is the most popular.

As regards the filter bed, there are two things that can strongly affect the absorption. The smaller the carbon grains (the granulation) we have in the carbon, the greater the increase in the speed of diffusion (speed of passage / spread through the carbon) so that a more rapid contact takes place both outside and inside the carbon. With granules or pellets of 1-3 mm or larger, there is almost no contact, and impurities do not reach the meso- or micro pores. It does not work. But exactly the same carbon with a finer granulation works well.

What we want are grains as small as possible. But if the grains are too small, a blockage will occur in the pipe's carbon bed and no filtration will take place. Soft carbon from peat or wood is usually 0.25-1 mm in size, and harder varieties from coal or coconut shell around 0.4-0.85 mm. These are very good, suitable grain sizes, giving the alcohol large contact surface with the carbon.

The quality of activated carbon is presently so varied that varieties of carbon with larger grains are usually preferred e.g., 0.4-1.4 mm, to ensure faster filtration. That way, we know it will work - if not perfectly, at least well.

The second matter influencing the absorption is the speed of filtration. This is measured in Bed volume per hour (HSV, Hourly Space Velocity), i.e., the quantity of purified alcohol per hour in relation to the volume of the pipe. The volume is easiest measured by filling the pipe with water.

Bed volume per hour (HSV) is usually around 0.25 (very, very slow) when purifying alcohol, while water is usually purified at 2-3 HSV. For a pipe holding 1.7 liters, the maximum purification occurs at 4 dl per hour if the pipe is approx. 40 mm wide and the carbon grain 0.4-1.4 mm in size. If the filtering speed is higher, the carbon sometimes cannot manage proper purification. There are only three ways to speed this up:

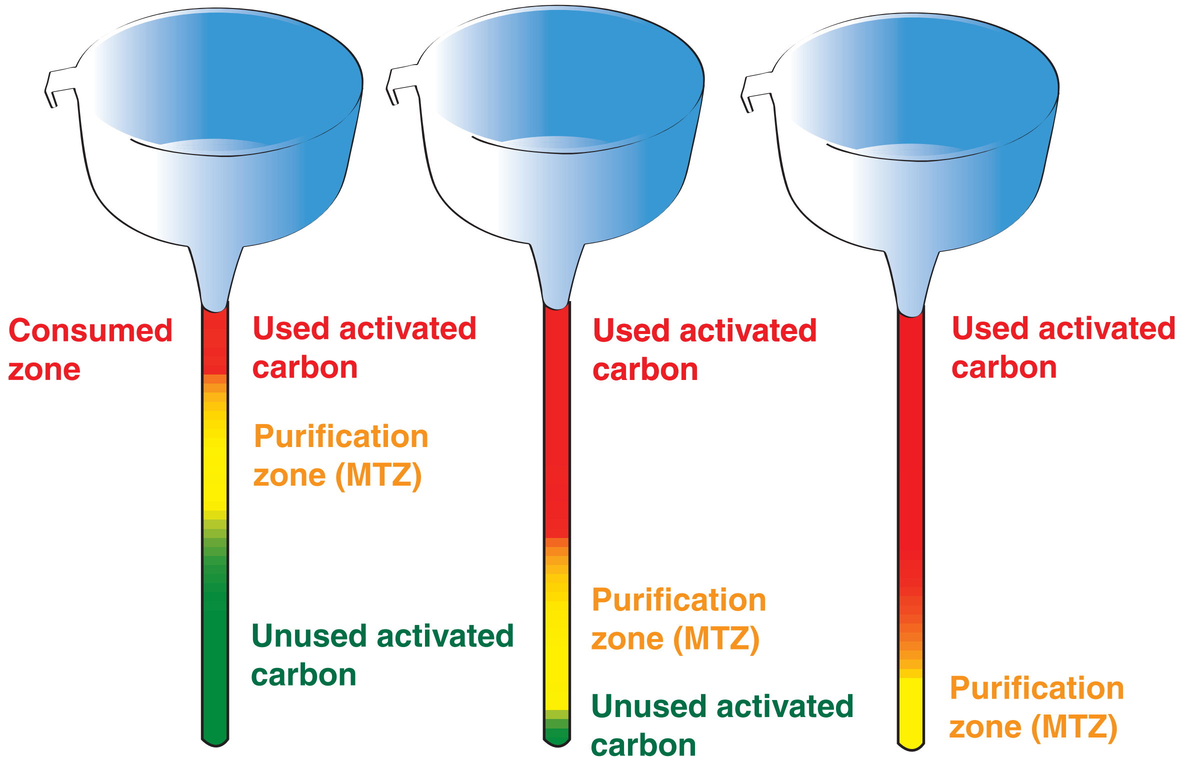
1. A wider pipe
2. A longer pipe
3. Smaller carbon grains

It is not possible to have a pipe narrower than 38 mm, because this would create a "wall effect" in the carbon bed, where impurities escape filtration along the wall of the pipe. If we increase the width of the pipe, the alcohol **volume** per hour is increased without increasing the flow **speed.** Within the alcohol industry this filter is over 1 meter wide and pumping the alcohol through the carbon bed from below at 0.25 HSV regulates the HSV.

Method comparison
Using the method I describe and a Prestige activated carbon or another carbon of the same capacity, one can often filtrate much faster then 0.25 HSV.

To describe how good this **“pre-wetting”** method works is easy. To purify 5 liters of alcohol 40-50% one normally needs 1 tube 40 mm x 1.5 meter, then one more to take the last 10% volatiles that remain (this can be used again next time as first filtration).

With the pre-wetting method, the same can be done in one filtration in a 1-meter tube, sometimes shorter.



In the purification process, three zones are formed in the carbon bed (the pipe). At the top, nearest to where the unpurified alcohol is poured in, is a zone known as the **consumed zone.**

Then comes a zone where the carbon is working and absorption of impurities is constant. This is the **Purification Zone** (MTZ).

After the MTZ zone, furthest down in the pipe, is a zone with activated carbon, which has not yet caught any impurities: **unconsummated carbon.**

During the purification process, the consumed zone and the purification zone will move farther and farther down the pipe until the unconsummated zone comes to an end. When this happens, all remaining impurities will pass through the bed and the alcohol filtration ceases.

Absorption occurs in the MTZ. The MTZ should be as **short** as possible. The larger the carbon grains (the smaller the contact surface) and the faster the speed of filtration (HSV), the longer the MTZ is. If the grains are 2-3 mm, the MTZ becomes longer that the pipe, and purification does **not** take place.

The MTZ can be shortened by:

1. **Using smaller granules**, which gives greater contact surface, e.g., 0.4-0.85 mm.
2. **A slower filtration** speed (HSV), to give longer contact time.

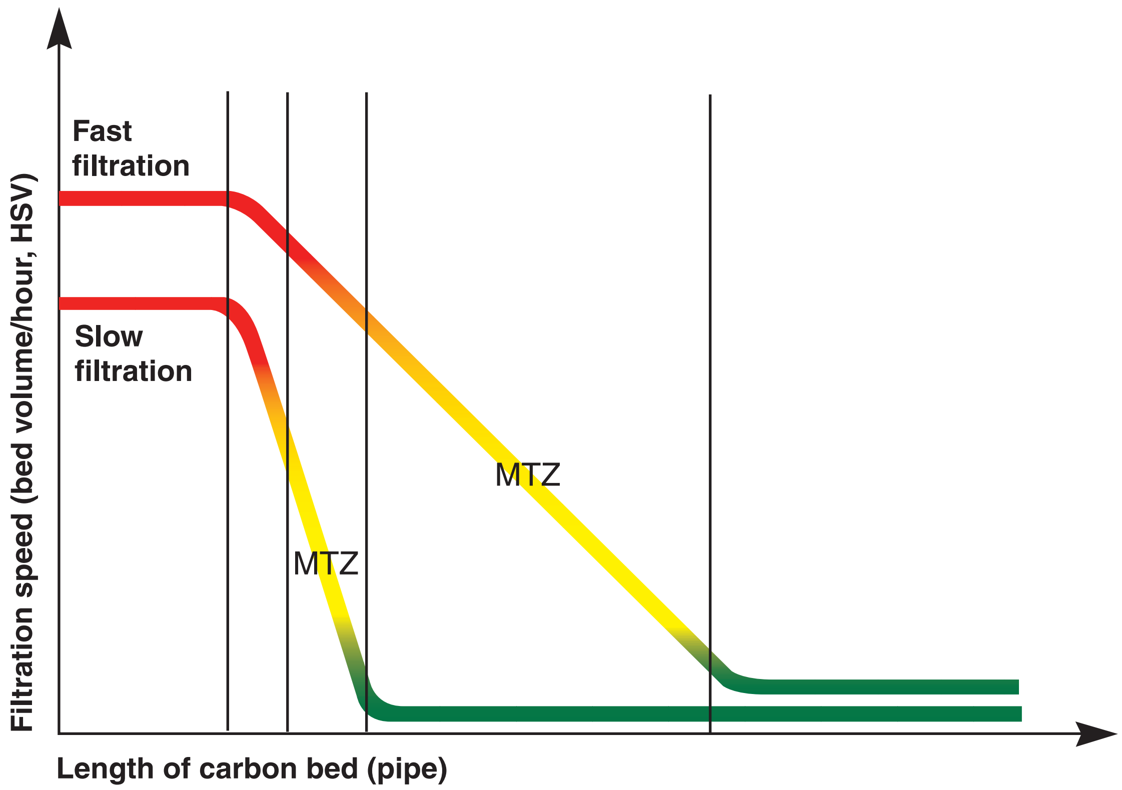
The filtration speed can be controlled by:

1. Selecting the carbon grain size
2. Packing the carbon in the pipe
3. Impeding the flow

If you are using carbon with a larger grain size, e.g., 0.4-1.4 mm, change to one that is smaller. Tap on the pipe to pack as much carbon in as possible. Be careful not to pack the peat carbon (0.25-1 mm) too hard, or it will block the pipe.

Impeding it mechanically can also slow the rate of speed. This has to take place **at the end of the pipe,** never at the top, or you would get air in the pipe. You can apply more or denser filter papers, or build and attach a tap or similar device. A rubber bung with a length of tubing and an aquarium tap is one example. You must use food-grade materials with alcohol tolerance, which do not give off-flavors to the alcohol for the impeding process.

A short MTZ means you can purify larger volumes through the carbon. If you cannot get a suitably short MTZ, you must extend the pipe.



Recycling activated carbon.
If you remove the impurities in the used activated carbon, it can be re-used. You can recover up to 80% of its effectiveness, which in practice is 100%, since one seldom uses the carbon to its limit. In theory this can be done as many times as you like. If the carbon is soft (e.g., peat carbon will degenerate with recycling), the grains become smaller every time. Hard varieties, like coconut or stone coal keep significantly better, and can be recycled hundreds of times.

There are two ways to recycle activated carbon:

1. With heat (thermal recycling)
2. With steam (steam recycling)

Recycling with heat within the industry is done as follows:

1. The carbon is dried.
2. It is then pre-heated so that the impurities in the carbon pores are carbonized.
3. The carbon is reactivated around 700-1000°C, when the carbonized impurities turn into gas and escape from the carbon. This is done in an oxygen-free environment to ensure that the carbon does not ignite. In this way, the pores become empty once again and the carbon can be reused.

It is not unusual for amateur distillers in some countries to **heat recycle** their activated carbon. **It is done as follows:**

Note: the carbon contains mostly fusel oils whose highest boiling point is 138°C. Fusel oils are higher alcohols like amyl, butyl and propyl alcohols and **their vapor is flammable**.

1. Begin by pouring the carbon into a sieve and rinsing it with hot water from the tap. If the carbon grains are 0.4-0.85 mm, they will go right through an ordinary kitchen sieve when rinsed, so you must get a sieve with a finer mesh or omit this step entirely.
2. Then, **boil** the carbon in water for 10-15 minutes, to dissolve some of the higher alcohols (already it has a 15-20% regeneration). Boil as long as it smells. Repeat if needed.
3. The carbon is then dried in a deep baking dish or roasting tray. When the carbon has dried, it is placed in an **electric** oven. **Note: keep the kitchen fan on and the window partly open, as the vapor can be flammable**.
4. Turn the oven on to 140°C or 150°C and heat up the carbon for 2-3 hours.
5. Turn the oven off and **let the carbon cool down** - now it is ready to be used again.

Remember that the impurities leaving the carbon when it is heated have a very bad smell. Also note that the danger of recycling carbon in the oven is that **it can ignite.** Carbon made from wood or peat ignites at approx. 200°C and stone carbon at approx. 400°C. Stone carbon can sometimes be recycled in the oven at 300-350°C if one wants to do so.

Recycling with steam is common in the alcohol industry and is done in the following manner:

1. The filter is back-flushed with hot water. This is done downward from above, since these carbon filters always works upward from below.
2. After that, the steam is connected and forced through the carbon. This too is done downward from above. The steam is 120-130°C and very soon the carbon is heated to the same temperature. All fusel oils and impurities are flushed out of the carbon pores.
3. Finally the carbon is back-flushed and is ready for use again.

I don't know of any amateurs who recycle with steam. If you are distilling your own alcohol and recycling the carbon with heat or steam, please drop me, Gert Strand, an e-mail and tell me of your experience (mailto: strand@partyman.se).

The recycling power of steam is very high, in fact the steam from a kettle is enough to recycle activated carbon. It is not impossible that in the future we will be able to connect an appliance to the still or a steam cleaner, and recycle the carbon this way. There are steam cleaners on the market, to buy or rent, with which you can steam clean walls, floors, houses and similar, in an environmentally friendly way, totally without chemicals.

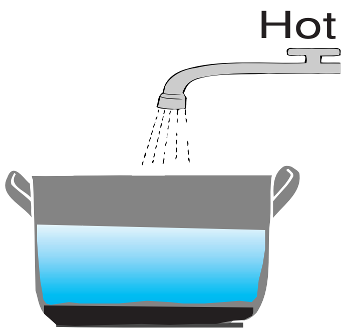
Filling a large sieve with carbon in a layer of 5-10 cm deep and then blowing it clean with the steam from a steam cleaner shouldn't be too difficult. The steam from a good cleaner is 145°C, with a pressure of 4.5 bar, and the cleaning process can be left unattended for an hour or longer. The water dripping from the bottom of the sieve can be tasted. When the carbon is clean the water will taste like water. Send me an e-mail – mailto:strand@partyman.se – if you have tried this, with photos if possible.

Effectiveness
The information in this document is intended for use in countries where home distillation is legal. Note: Home distillation is prohibited in many countries. It is the responsibility of the reader to abide by the law in his/her home country. However, many countries also have freedom of information, which allows reading and writing on the subject. Here is the information on the effectiveness of high-quality activated carbon:

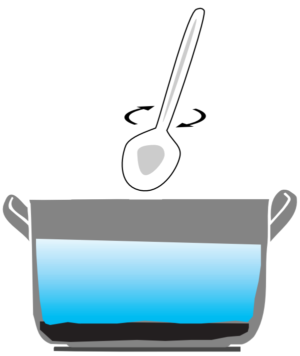
Activated carbon is more effective if high layers of granules are used. Fill a tube with granulated carbon. Normally a 1.5-meter-long tube with a 40-mm diameter is used. Filtration should be as slow as possible, without actually being blocked or stopped. The alcohol must flow **through** the carbon granules if the purification is to be as effective as possible. Make sure no alcohol bypasses the carbon, and make sure the tube is free from air.

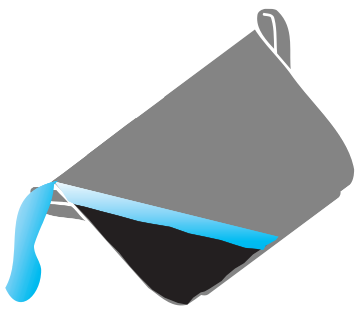
Effectiveness can be increased significantly

Increase the purification effect of carbon by 100%



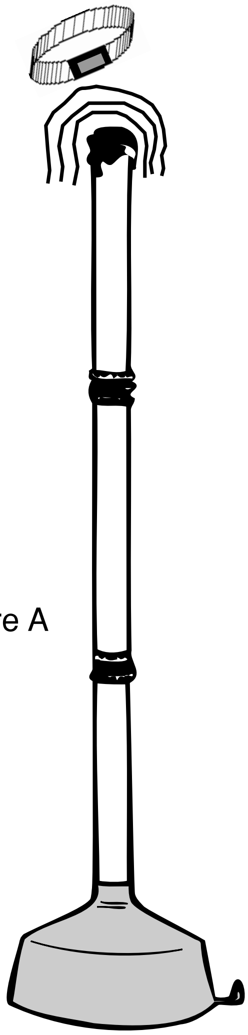
1. Pour the carbon into a stainless steel saucepan and add at least twice as much hot or boiling water.



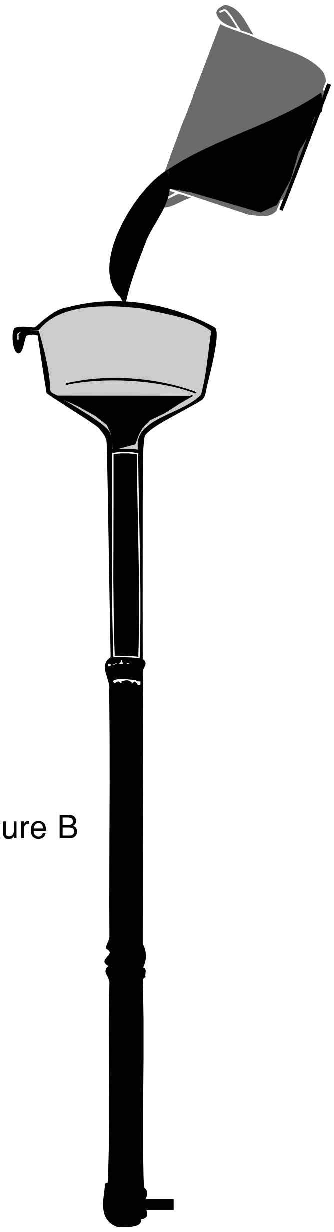


Stir with a large spoon and allow the carbon to sink to the bottom of the saucepan before discarding the surplus water. Repeat this process 4-5 times so that all soluble substances in the carbon pores are washed out and it is **saturated** with water.

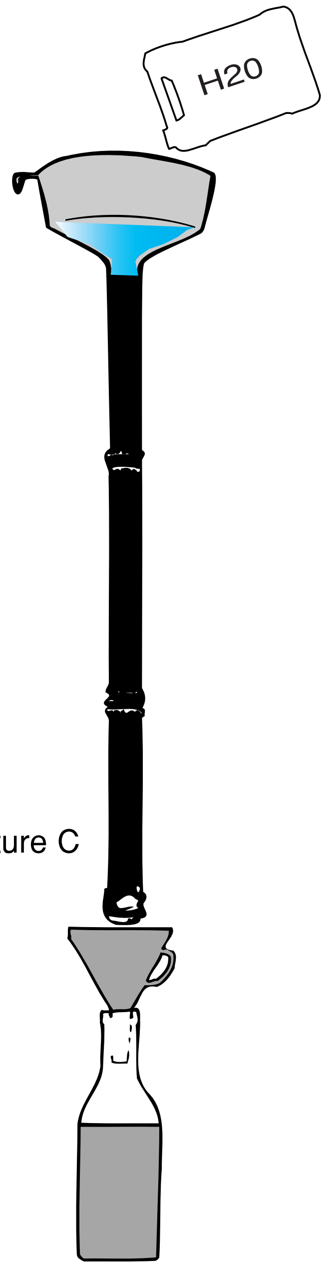
Picture A



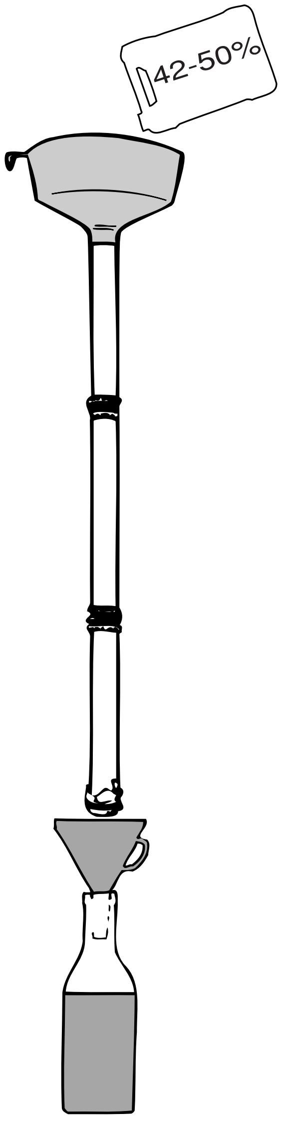
Picture B



Picture C



2. Attach 2-3 filters to the tube (Picture A), and completely fill the tube with warm water. Fill up with carbon, making sure it is poured into the water and all air is expelled (Picture B). Tap the tube to settle and pack the carbon. Filter 2-5 liters of water through the tube to flush out the remaining soluble substances (Picture C).



3. Pour in alcohol as the last drops of water drain from the funnel. Taste the filtered water/alcohol, and as soon as the alcohol emerges, let it run into a container. Cover the funnel with a lid to avoid vaporization of the alcohol.

4. When the last drops of alcohol leave the funnel, pour in a liter of water to ensure that all alcohol is filtered through. Again, taste the filtered alcohol/water, and discard the water.

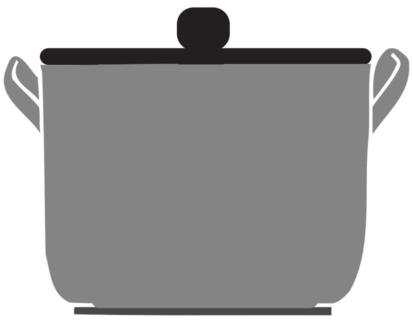
5. This way, the carbon is started, and all air in the tube is expelled. It also eliminates the bypass “channels” formed when using dry carbon, and prevents changes in the pH-value (from 7 to 10) that normally occur when the soluble substances in the carbon are dissolved in water or alcohol.
   Once the carbon has been **heated and soaked**, and when all air is expelled from the tube, the alcohol will flow **through** the channels in the carbon, and not escape unfiltered. Effectiveness is increased by at least 100%, giving a cleaner alcohol, and it is possible to filter twice the volume **much** faster.

The diameter of the tube should not be less than 38 mm. If it is, too much alcohol escapes unfiltered along the inner wall (wall effect).

Increase the purification effect of carbon by 150%

1. Pour the carbon into a stainless steel saucepan, and fill with at least twice as much boiling water.

2. Stir with a large spoon, allow the carbon to sink to the bottom of the saucepan before discarding the surplus water. Repeat the process 4-5 times, making sure all soluble substances in the carbon have been washed out.

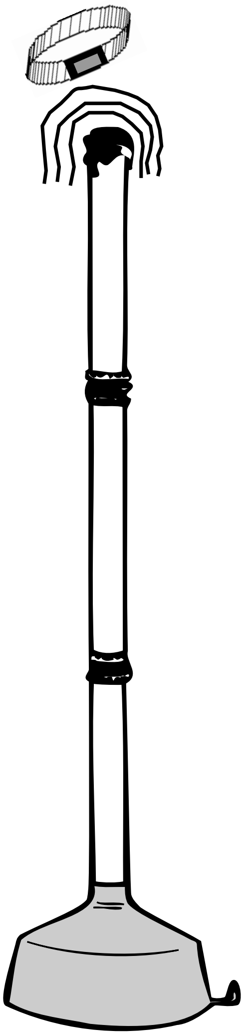


Cover with boiling water, put a lid on the saucepan, and **leave it to soak for 24 hours.** It is **the internal wetting** within the carbon granule that **mostly increase the purification** effect. Those 24 hours add 50% more so we can use **the whole capacity** of the activated carbon.

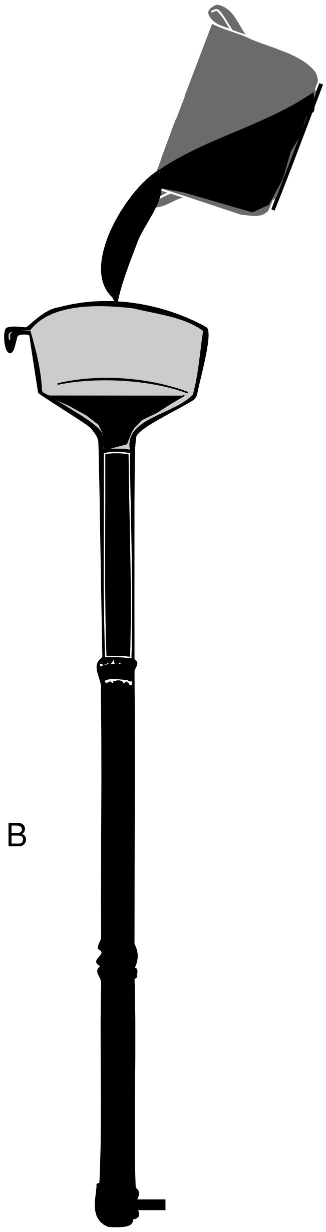
3. Discard surplus water and cover once more with hot or boiling water.

4. Stir and pour off remaining water.

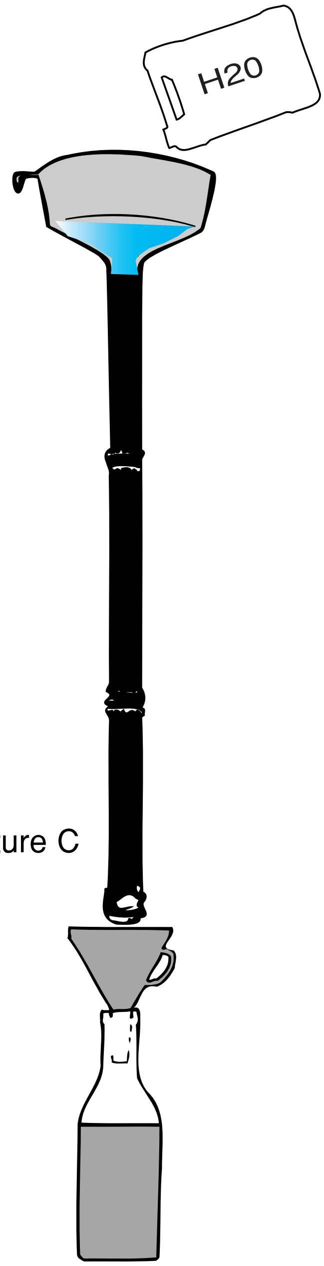
Picture A



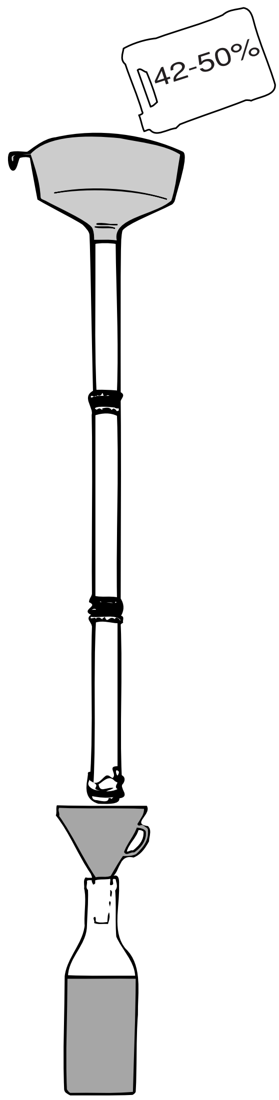
Picture B



Picture C



5. Attach 2-3 filters to the tube (Picture A),and fill completely with warm water. Fill up with carbon, making sure it is poured into the water and all air is expelled (Picture B). Tap the tube to settle and pack the carbon. Filter 2-5 liters of water through the tube to flush out the remaining soluble substances (Picture C).



6. Pour in alcohol as the last drops of water drain from the funnel. Taste the filtered water/alcohol, and as soon as the alcohol emerges, let it run into a container. Cover the funnel with a lid to avoid vaporization of the alcohol.

7. When the last drops of alcohol leave the funnel, pour in a liter of water to ensure that all alcohol is filtered through. Again, taste the filtered alcohol/water, and discard the water.

8. This way, the carbon is started, and all air in the tube is expelled. It also eliminates the bypass “channels” formed when using dry carbon, and prevents changes in the pH-value (from 7 to 10) that normally occur when the soluble substances in the carbon are dissolved in water or alcohol.
   Once the carbon has been heated and **soaked,** and when all air is expelled from the tube, the alcohol will flow **through** the channels in the carbon, and not escape unfiltered. Effectiveness is increased by at least 100%, giving a cleaner alcohol, and it is possible to filter twice the volume **much** faster.

The diameter of the tube should not be less than 38 mm. If it is, too much alcohol escapes unfiltered along the inner wall (wall effect).

Some useful distillation tips

Preparing the mash and getting better-tasting alcohol
Europeans take this information for granted, since they often distill fruit schnapps: Gheist. In the early stages they noticed that sediment in wine produced bad-tasting and foul-smelling distilled alcohol. This happened when the sediment “burned” in the places where the pot was heated up. The problem was solved two ways:

1. By not using direct heat. Instead a “water bottle” was placed around the pot and filled with hot water.
2. By clarifying the wine. A crystal-clear wine does not leave any off-flavors in the alcohol. The same goes for the mash. Leave it to clear and siphon the crystal clear mash before distillation. If the mash doesn’t clear, leave it for a few days, preferably in a cool place (an old fridge will do). If it’s still cloudy, add wine fining. It can also be filtered through a coarse wine filter.

A useful distillation tip
Alcohol was always distilled twice in the traditional Swedish distilleries. The first distillation was quick and of low quality. This produced the raw spirit, which was diluted with water to 50%, distilled a second time in a column still at 78°C.

Home distillers can do this as well. First, a quick distillation (stripping) and then dilute with water to 40-50% (otherwise it will boil dry and the alcohol will not be as pure). Distill a second time - several fermentations can be distilled as one batch at the same time. It’s easier to maintain the temperature and the result is a cleaner alcohol since many of the impurities are separated out during the first distillation.

Mysterious bad taste in home distilled alcohol
One has done everything right but the distilled alcohol smells and tastes a lot of volatile. Maybe you have distilled good vodka for the second time and it comes out worst. There is no explanation.

This use to come from the column filling. The column shall always be back flushed with hot water from the tap. At least every third time (every time if you use pot scrubbers, also before the first run) the column filling shall be rinsed with GLASRENS. This is a super effective cleaner, high in pH and containing chloride. Dissolve 2 teaspoons in 2.5 liters (1/2 gallon) warm water. Put the column filling (rashig rings or similar) into the solution and leave it for 15-20 minutes. Rinse everything thoroughly and accurately with pure and warm water, then let it dry.

Cleaning of a copper still with GLASRENS
GLASRENS is one of the best cleaners available. But it is high in pH and copper does not like high pH cleaners, it turns black. But this takes times.
GLASRENS works great if the cleaning is done within 15 minutes. Dissolve 2 teaspoons in 5 liters (1 gallon) warm water. Put the copper still parts into the solution and leave it for 10-15 minutes. Rinse everything thoroughly and accurately with pure and warm water, then let it dry. One can also mix some acid, for example 25-gram citric acid with 5 liter (1 gallon) of water and rinse with after GLASRENS. It neutralizes all high pH particles that are left.