



## Hop Storage

Hops have three main ingredients that brewers care about:

The alpha acids, the beta acids and the essential oils. Normally we concern ourselves with only two of the three: alpha acids and the oils. The alpha acids are bitter, but they don't dissolve well in beer so they need to be changed into a form that does dissolve well. In brewing, this is caused by boiling and the process is known as isomerization. The resulting isomerized alpha acids are soluble in beer and are still bitter. The beta acids are not bitter and they are not isomerized by boiling (nor are they changed into a bitter form). They are, however, bitter when oxidized. The oils are responsible for the aroma of the hops, and enter into the beer's flavour profile for short boil times, steeping, used in a hop back or dry hopped. All of these three components undergo changes as the hops age.

### Hop Harvesting and Processing

All hops are harvested once per year, beginning as early as late August and continuing through October, depending on the hop variety. The hops are dried and in the US, baled in 200 lb bales. The bales are made by compressing the hops and then wrapping them in burlap. Some of the hops will be ground and pressed into pellets. Some hops in the UK are compressed into "plugs" that weigh about 1/2 an ounce. The level of compression in these plugs is much higher than the level in the bale. In Germany, some hops are compressed into 11 lb "bricks" and then vacuum sealed. The level of compression is about 3-4 times that of the US bale. (And by the way (BTW), in the UK the plugs are known as pellets)

The hops are then stored in huge warehouses at around 30 degrees F (this temperature differs depending on the broker, and the outside temperature). They stay there until they are shipped to a brewer or hop supplier. Most small brewers buy enough hops at the start of the hop season to last all year, but they are stored at the hop broker and shipped periodically to the brewer. This keeps the brewer from needing a huge cold storage facility. Also since most small brewers don't have hop analysis equipment, this allows the hop broker to keep tabs on the alpha acid and oil contents as they change over time. Only the megabrewers pay to have their hops shipped refrigerated.

### Hop Deterioration

Hops start to lose their alpha acids and oils as soon as they are harvested. The rate is dependent on the storage temperature, amount of air present and the hop variety. Basically, the lower the temperature, the less the hops deteriorate. Oxygen also causes the alpha acids to oxidise and one of the oxidation components is responsible for the "cheesy" aroma of old hops. The oxidized alpha acids cannot be isomerized and are no longer bitter. So O<sub>2</sub> is definitely bad for alpha acids. If you remember, the beta acids turn bitter when they are oxidized, so some believe that this makes up for the loss of alpha acids. In fact, it has been argued that cold storage and anaerobic conditions are not necessary for bittering hops, as long as the boil is long enough and open enough to allow the cheesy aroma to escape. But brewers aren't buying the argument (who can blame them).

The variety of the hop also plays a major role. For reasons yet unknown certain hops store better than others under the same storage conditions. The American Society of Brewing Chemists has a procedure for measuring the "storageability" of hops called the Hop Storage Index and involves taking readings of hops stored at 20C (68F) when "fresh" and six months later. Unfortunately, this only gives us two points on a curve and compares the storage properties of one variety vs. the other, but won't help us predict what happens to the same variety for differing storage times. The oils also deteriorate and oxidise over time. It is believed that some oxidation of the oils is beneficial to the hop aroma. Since most homebrewers have no idea what the oil content of their hops are (a fact I'd like to see changed), they're not aware of the oil losses. But they should be since knowing the oil content is just as important for aroma additions as knowing the alpha acids is for bittering additions. And consistency of results aside, a lot of brewers end up using more hops by weight for finishing and dry hopping than for bittering. So it makes economic sense to know the oil content. (OK, I'll get off my soapbox.)

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So for best storage conditions, the hops should be stored as cold as possible (-20 to 0C) and away from air. The compression of the hops into bales, pellets and plugs helps keep all but the surface layers away from air. Even so, air still penetrates and causes some oxidation. The cold temperature slows the oxidation process. As was mentioned earlier, some hop varieties don't store as well as others. At some point in the season, hop brokers will take all remaining unsold bales of poor storage hops and turn them into pellets. Not only does the pellet keep out a lot of oxygen, but since they take up so little space they can now be vacuum packed to further slow the deterioration.