

Hawaii Coffee Association



Kauai Big Island Maui Molokai Oahu



14th ANNUAL COFERENCE AND TRADE SHOW
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MAUI TROPICAL PLANTATION

BASICS OF COFFEE ROASTING

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14th Annual Conference - Basics of Roasting

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Green Coffee

Though quality & “defects” are relative to any given varietal or cultivar of coffee, care should be taken to choose the most defect free coffee available for roasting. Limit the use of green that has a high number of blackjacks, sticks, hulls, broken, etc... Bean size, also relative to the type of coffee, needs to be uniform for each batch. This will allow for even roasting.

The moisture content of green coffee needs to be maintained at 10% to 12%. Generally speaking, this may be accomplished by storing the green at or below 72°F and 55% to 70% humidity. These parameters will vary from location to location based on ambient conditions.

It is equally important that green coffee be stored in an area where it can breathe yet not be contaminated by odors and/or moisture. Coffee that has not breathed properly will tend to have a grassy or grainy profile after roasting. Micro-lots of green coffee that have been vacuum packed for shipping should be allowed to breathe for twenty four hours before roasting occurs.

Before roasting, the green coffee needs to be passed through equipment to remove any foreign objects. This may also be accomplished by poring the coffee through a large screen to remove burlap, wood, or sticks and then passed over a magnet to remove metal. This is essential to limiting equipment damage for you and your customers.

Impact of moisture on roasting

Roasting of coffee at the ideal moisture content (9.5% to 10.5%) will typically give a dark chocolate color at a medium roast, with a percentage weight loss between 8% and 12%. During the process of brewing, beans of this type will give you a proper extraction, which will represent balanced acidity, body and flavor. Beans with a high moisture content (11+%) usually take longer to roast, but more important, the beans will first "bake" prior to roasting.

This baking process creates a light colored, soft bean, which forces over-roasting, giving a light acidity, full body and negative flavors in the cup. Beans that have been baked become soft and permeable. After grinding these beans will give an uneven grind that is highly solvent in water, creating dissolved impurities that build excessive high body in the cup.

During this process, the beans will lose desirable acidity and natural flavors.

Brewed coffee from high quality beans with proper moisture content will be clearer to the eye, more like a thick honey color because of having fewer impurities. This type of coffee usually has a sweet balanced cup with good acidity, quality and taste.



Examples of Imperfections



Full Black



Full Sour



Pod Or Cherry



Shells



Broken or Cut



Partly Black



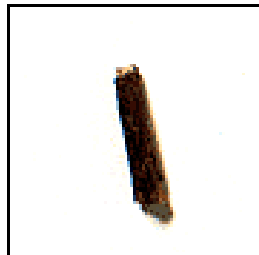
Partly Sour



Floaters



Small Sticks



Medium Stick



Large Stick



Hull or Husks



Small Stones



Medium Stones



Large Stone



Parchments

Equipment

Roasters

For centuries, with nothing more than a “pan” of some sort over a fire, the consumer had roasted coffee just before brewing at home. With the advent of industry and consumerism there grew a need to roast coffee on a larger scale, thus roasters as we know them today were born.

In its basic form roasting equipment hasn't changed much in the last one hundred fifty years. Generally speaking a roaster consists of a heat source (burner), roasting chamber and a cooler. Coffee is received into the roasting chamber where heat is added and pyrolysis is completed. At this time the coffee is transferred to the cooling section where it will be prepped for further processing (grinding or packaging).

With so many choices on the market today, it may become difficult to find the “best” roasting equipment. Ultimately it must be something that fits your business size and structure, and is able to produce a product you are proud of.

Drum Roasters

Industrial

General uses would be for large national brand coffees that require many thousands of pounds being produced daily.

Industrial roasters are very large roasters and capable of batch sizes of over 250lbs, or even capable of continuous roasting. As the illustration on the next page shows, coffee is received above the drum. Once the coffee has entered the roasting chamber hot air from the burner is passed through the coffee and recycled. Before the air returns to the burner it is passed through a collector where chaff is removed. When the supply air finally reaches the burner it is reheated and the process repeats until the batch has finished roasting. Once the coffee has been roasted to the desired level it is quenched with water, evacuated to a cooler, and passed through a destoner. At this point the coffee is ready for packaging.

Not only do Industrial Roasters offer greater capacity, they also give greater flexibility and control of the roasting process. Modern computer controls increase consistency and reduce labor cost. Also, due to the size of the equipment, engineers are able to incorporate many mechanisms to better control thermal transfer and air velocities. Air is recycled from the drum to the burner reducing fuel consumption and removing of chaff. Additionally, items such as a quench tube can better control the end process of a roast or a destoner may help save other equipment such as a grinder from damage. All of this allows for a cleaner cup at less expense.



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The claim that quality has been compromised in drum roasters over other types of equipment tends to be unproven in modern times. With variable speed drums, tight air control and a good Roast Master most if not all quality issues can be mitigated.

Companies who carry smaller inventories of finished goods may find that this type of equipment does not meet their needs. Due to the batch sizes, they would be forced to carry inventories much larger than would be economically feasible.

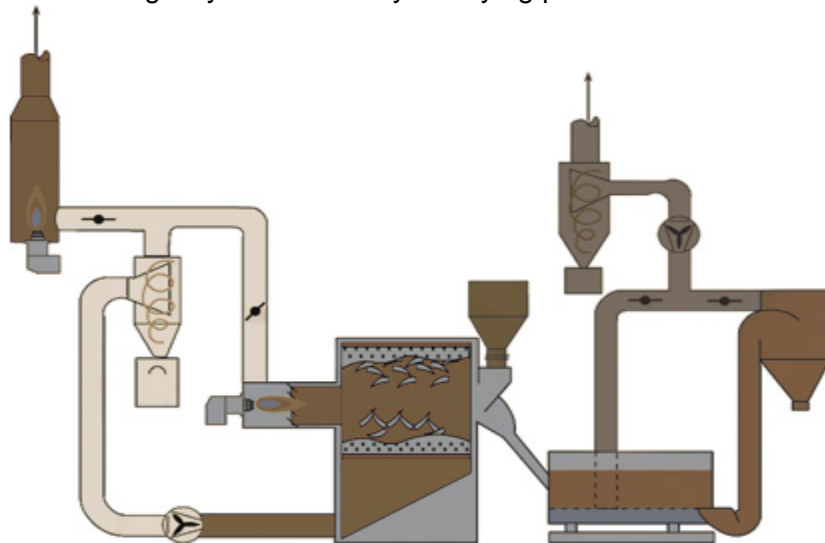
Shop Roasters

Shop roasters (generally drum roasters) have a capacity of 5 pounds to 50 lbs. This type of equipment is a great entry-level way to roast coffee. With equipment cost a fraction of an industrial size roaster and batch sizes more closely suited to a smaller business, shop roasters are a sound choice for many.

Over all operation and engineering of shop roaster remains the same as an Industrial roaster, though in very basic ways. There are roasters that fall into a category between these two roasters, however their operation remains similar to the two roasters mentioned here. Due to the size of and cost of the equipment, they are limited on the amount of control available.

In years past shop roasters have been limited to just basic forms of roasting, doing not much more than circulating the coffee while adding heat. One of its major downfalls was having little to no airflow control. In more recent years technology has been added to the equipment allowing for better air flow in the roasting chamber, finer control of the burner and addition of secondary equipment approaching levels available on industrial roasters.

Also, with the melding of computers & roasting on both industrial & shop roasting, repeatability and control have come a long ways from the days of frying pans.



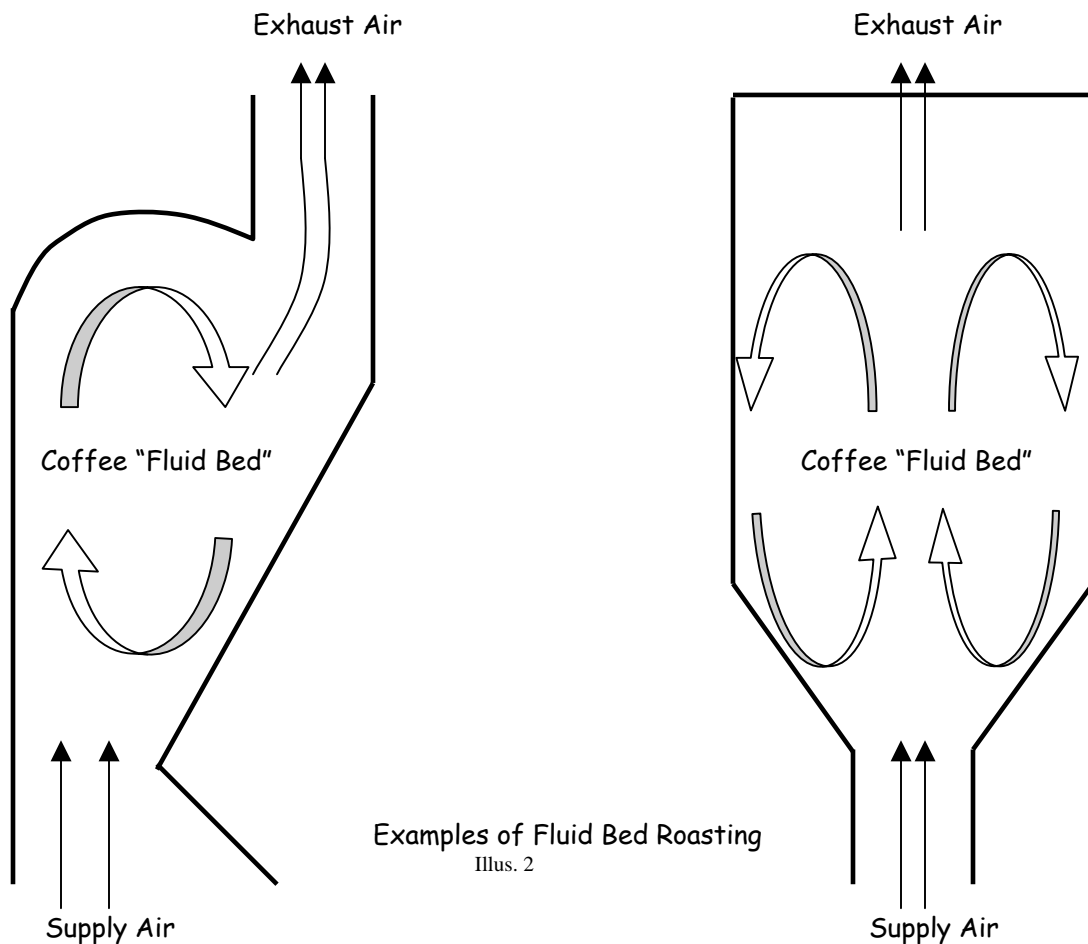
Illus. 1

Fluid Bed Roasters

Fluid Bed Roasters are the newest addition to the roasting line-up. Beans are loaded into a stationary roasting chamber. Hot air is forced up through the coffee from a combustion chamber located either at the bottom or side, by a blower. This causes the coffee to tumble in the air stream and reducing contact with surfaces that may cause scorching.

Because the bean is fully enveloped with the supply air and less energy is used to heat a drum, burner temperature may be lower than other roasting methods. It is believed that this further helps to minimize scorching.

These systems do not re-circulate air as most drum roasters do. It is thought that because the air does not pass back through the burner large particles do not get processed further into smoke. Many people feel that because of this the finished cup tends to be cleaner.





Operating Systems

Craft Roasting

A roaster is nothing more than a paintbrush for an artist, a tool to used to create an engineered product. Whatever your choice of roasting equipment, knowing and understanding their practical use is key to creating a great cup of coffee. Every roaster will act different from the next and every bean unique to itself. These coupled with ever changing environmental factors make roasting a challenge on the very best of days. However, a qualified Roast Master who is in tune with their equipment is able to cope with all of these factors.

Craft Roasting is the art of creating roast profiles, understanding and being able to control the equipment to create the environment needed to bring out the desired qualities of the coffee. It may take many hours of training to truly master roasting. Ultimately, desire and attentiveness will be the deciding factors between someone who craft roasts and someone who just roasts.

With an experienced operator taking total control of the equipment, temperature and airflow are hand controlled to bring out the desired characteristics of the coffee. Through documentation and full analysis of the finished product, both consistency and uniqueness can be achieved.

Profiling Systems

Profile roasting is the establishment of roaster presets and repeating the various stages of the roasting process for each bean or blend. Though this can be tracked and repeated manually – still being classified as a profile – technology has finally taken the reigns.

The process starts out with craft roasting. A Roast Master chooses the coffee and finds the desired parameters to roast it. These parameters are either logged in by or entered into a computer, which controls the roasting equipment. From there the computer will control the roasting conditions, such as air flow, burner temperature and time at given intervals on each batch thereafter.

This system is great for quality and consistence. Not only does it duplicate the finished taste profile, it helps controls factors such as shrinkage and fuel usage. Furthermore, personnel with less experience may operate the equipment with out deviating from standards.

These systems vary from manufacturer to manufacturer and training on its use should be performed by the Original Equipment Manufacturer.



Roasting

Roasting is more than just prepping green coffee for brewing. This is a chance for a skilled person to bring out, create or suppress various elements of the coffee. All training aside, roasting takes hours and hours of hands on practice. Knowing when to pull a roast, when to crank the heat and when to turn the heat down are all intuitions built by experience with the equipment and the coffee. With that being said, there is no “right way” to roast. Ultimately you need to create a product you and your customers enjoy drinking and you are proud to sell. If you choose to roast in 8 minutes or 20 minutes, the end product should be purposeful, not an accident.

The following is a general guideline for roasting with tips to point you in the right direction. You should always start with a pre-heated roaster. Allow the roaster and burner to idle for 20 – 30 minutes before dropping your first batch. Creating a stable starting point for the coffee, especially if you are doing multiple roasts.

After the equipment is pre-heated, green coffee beans are placed in the roaster. As the roast heats up, the beans are tumbled allowing the coffee to heat evenly. The temperature slowly rises and moisture is driven off. As the process continues the sugars are caramelized and the roast is completed. While this is happening, you will notice physical changes to the coffee as discussed below.

Color Change

As the green coffee loses its moisture, you’ll notice the color changing from green to a pale yellow. As the roasting process continues the yellow will develop into a tan or light brown.

First Crack

When the coffee has reached a temperature of 390°F to 400°F the coffee beans will increase in size significantly. Soon thereafter, a loud cracking noise will be heard as the remaining moisture bursts out of the coffee beans. At this point, the sugars in the coffee have begun to caramelize. This would generally be the lightest roast anyone would use.

Caramelizing

After the first crack, the coffee begins to roast more quickly. During this phase, the color darkens rapidly and requires a close eye and quick timing to achieve precise roast levels.

Second Crack

Many roasters stop the roast before the second crack, however excellent coffee can be found at or beyond this level, if so desired. The second crack may be harder to identify than the first crack, if it occurs at all. If you have reached this stage, you should remain focused on the roast, as the color may change in a fraction of a second.

Ending the Roast

Stopping the roast is critical. Once the desired color has been reached, whether it is at the first or second crack, the coffee must be removed from the heat. It may be evacuated to a cooling pan or quenched with water to stop the roasting process. If the later is chosen, care must be taken that the coffee is not moistened to the point it will stale or mold.

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Stalling

After the coffee is roasted, the beans should rest for 24 hours to allow carbon dioxide (Co₂) to dissipate from the coffee before being brewed. This can be done as whole bean or ground.

Use your senses to roast!

Sight

Lighting is KEY – use as much natural light as possible

Color of the coffee – use the color at various stages of the roast to guide you

Texture – example; coffee becomes “corrugated” just before the first crack

Smoke – Watch to see the smoke coincides with “Crack”

Sound

Listen for: First Crack & Second Crack

Keep in mind when they finish and how long they last

Smell

Grassy? It's just before the first Crack

Roasted Peanuts “smell”? The first crack just finished

It smells like coffee? Listen for the second crack

Is something burning? Maybe a French Roast

Consistency

Use the same amount of coffee every time. Try to create a repeatable environment, start with the same drop temperature and the same warm-up time.

Time







Remember to let the coffee develop. Roasting to less than 10 minutes will leave the coffee tasting very acidic and grassy. Roasting coffee beyond 18 minutes leaves it tasting baked and flat.

Taste Your Product

You have no idea how well you roast if you don't taste it



Coffee Roast Style Chart

Roast Color	Name of Roast	Bean Surface	Ave. Bean Temp. (at end of roast)	Acidity	Body	Aroma	Sweetness	Comments
	Light Brown/ Cinnamon	Dry	380- 400 °F "First crack"	High	Weak	Medium	Low	Very light roast that is rarely used. Can taste grainy and sour.
	Medium light Brown/ American	Dry	400- 415 °F	High	Full	Full	Mild	Common roast in eastern US
	Full Medium Brown/ City	Dry	415- 435 °F "second crack"	High	Full	Strong	Mild	Common roast in western US
	Medium-dark brown/ Full City/ Viennese/ Light French	Slight oily surface	435- 445 °F	Medium	Very full	Strong	Strong	Common roast in Pacific northwest
	Dark brown/ French/ Espresso	Shiny surface	445-460 °F	Low	Full	Medium	Full	Common roast for France and Italy
	Very dark (nearly black)/ Dark French/ Spanish	Very shiny surface	460- 480 °F	very low	Weak	Mild	Low	Burned tones are distinct or even dominate. Not popular in the US.

Note: the above colors may not be accurate due to color changes that can occur with individual computer and web browser settings.



Knowing Your Coffee Roast Levels

Roasting coffee causes the sugars, fats, and starches contained in the bean to emulsify, caramelize, and release. The delicate coffee oil that results from roasting is what gives coffee its unique, distinctive aroma and taste.

In general, lighter roasts tend to be sharper and more acidic than darker roasts. Darker roasts have a fuller flavor, though. Coffee that is over-roasted tends to have a smoky, charcoal-like, or burned flavor (not desirable). Interestingly, darker roasts actually have *less caffeine* than the lighter roasts. Every coffee is different, though. Colombian coffee will taste different than Sumatra coffee, even if the roast level is exactly the same.

Light Roasts

(Cinnamon, Half City, Light, New England)

the bean is light brown and dry with no visible oils on the surface of the bean. The flavor is baked or bread-like, similar to toasted grain. Depending on the coffee, some sour tones may be present and the body of the coffee will be minimal. New England roast (not very common) is a little darker than Cinnamon roast.

Medium Roasts

(American, Breakfast, Brown, City, Medium)

Medium light brown beans. The American roast is the most common roast used for cupping and professional coffee tasting. An official Medium or City roast (more common in the Western U.S) is slightly darker than American (more common in the Eastern and Southern U.S.), and is an excellent choice for tasting the differences between most varietal.

Medium-Dark to Dark Roasts

(Full City, Light French, Viennese)

Medium dark brown beans. Some oily drops will be present on the surface of the bean when roasted Full City. Full City roasted coffee will exhibit some chocolate or caramel undertones. Light French or Viennese is ever so slightly darker than Full City.

Dark/High Roasts

(After Dinner, Continental, European, French, New Orleans, and Espresso)

At this level, the beans are very dark brown (but not black). French roasted beans are shiny with an oil coating on the surface. Some burned undertones will be present and acidity is lower. This is a popular roast for making espresso, though lighter roasts are used also. Many people believe French roast to be the darkest roast, but they have not had *Spanish roast* yet...

Very Dark Roasts

(Dark French, Italian, Spanish)

Spanish is the darkest roast of all (Dark French and Italian is a little lighter). The coffee beans are nearly black in color and the flavor tends to be flat with charcoal undertones. Pretty much all of the sugar in the beans has been caramelized and toasted thoroughly. Most Americans would turn their noses up to coffee this overcooked but, hey, to each his own.

NOTES: