

Espresso Equipment

by Danamark Watercare

This module on Espresso Equipment is broken down into three sections:

- Introduction to espresso
- Types of espresso machines
- How water quality impacts espresso



Part One
Introduction to Espresso



By all estimates, Specialty Coffee is the fastest growing segment of the coffee industry.

This group of coffee professionals engages in a never ending quest to produce ‘The Perfect Cup’ from a selection of coffee beans, roasting techniques, and brewing methods imported from around the globe.



Specialty Coffee

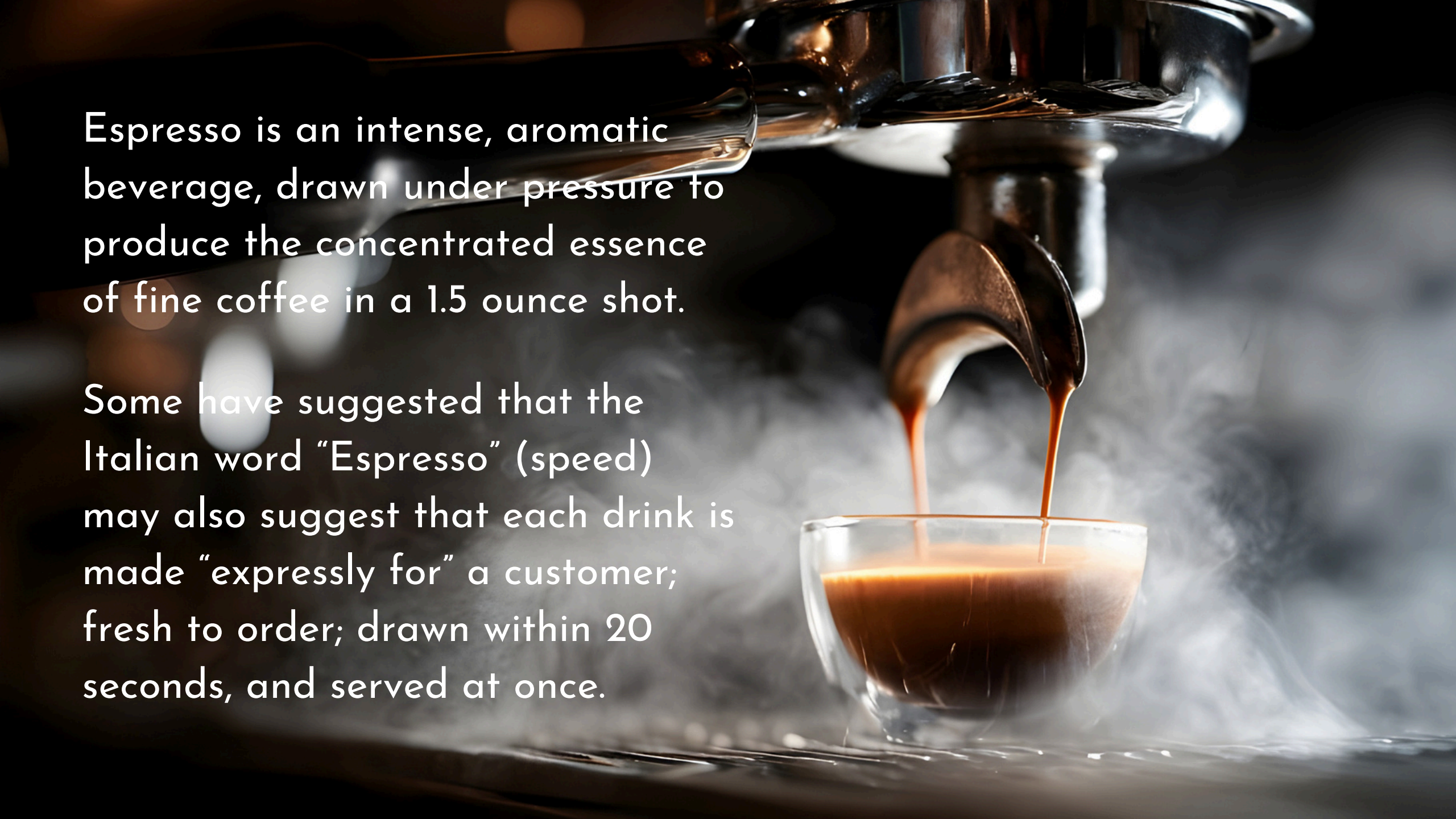
Specialty Coffee is very focused on maximum control during the entire process:

- Growing, selection and roasting of robust beans for precise aromas and flavours
- Coffee grinding to expose the correct surface area and control density for brewing
- 3.25 to 4.25 ounces of coffee grind (depending upon style) to ½ gallon of hot water
- Brewing temperature control at 195 degrees F
- Flow control through the coffee grind for optimum extraction rates
- 1.15 to 1.35% Coffee Soluble Content for target strength in the final drink



Espresso

Contrary to popular belief, espresso is not any specific type of bean, blend, roast or grind; though these factors are important ones that will effect the flavour and character of any coffee beverage.



Espresso is an intense, aromatic beverage, drawn under pressure to produce the concentrated essence of fine coffee in a 1.5 ounce shot.

Some have suggested that the Italian word “Espresso” (speed) may also suggest that each drink is made “expressly for” a customer; fresh to order; drawn within 20 seconds, and served at once.



Espresso coffee beans are usually dark roasted and finely ground to release the intense flavours required for this drink.

Approximately 7 grams of the coffee grind is packed into a metal porta-filter and locked into the espresso machine.



Cold water enters the steam boiler and is heated to between 195-205 degrees F, then forced through the grind at very high pressure. The brewing process is completed in less than 20 seconds, and produces about 1.5 ounces of liquid espresso drink.

The balance of the water supply is superheated to steam and dispensed through an arm or “wand” to produce steamed milk for a variety of drinks.

Part Two

Types of Espresso Machines

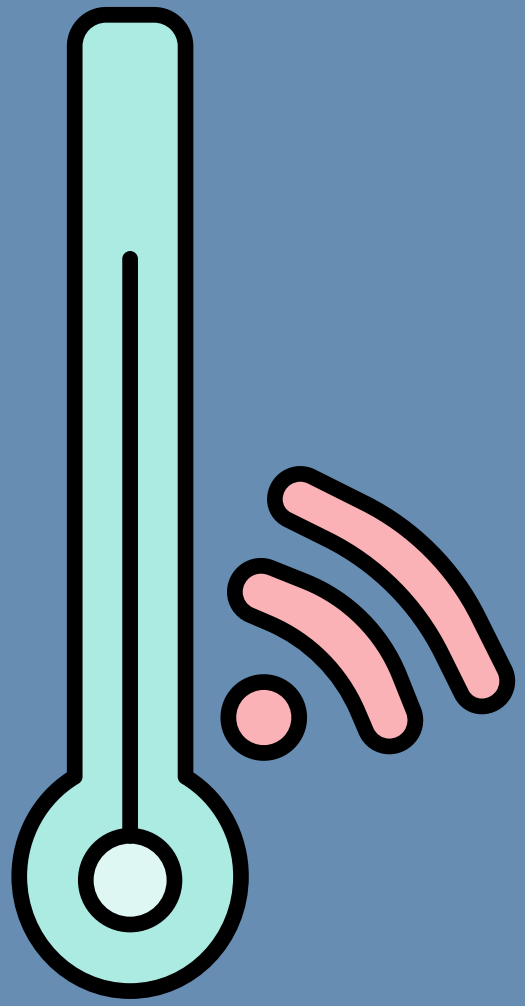


How does an espresso machine work?

Espresso machines are complex for their size. Key components are the pump, which draws water from the reservoir, the boiler, and the portafilter, part of the group head.

Most machines use an electric pump to force water through the compacted coffee in the portafilter—where preferred pressure is 9 bar or 130 PSI.

(in comparison, car tires are about 30-35 PSI)



Water temperature is between 195 - 205 F. Water temperature must be very steady— otherwise, the rate of extraction varies, which impacts the flavour of the shot.

Because precise temperature control is so essential, many manufacturers utilize proportional-integral-derivative controllers (PID) or digital temperature controls.



The hot, high-pressure water circulates through the coffee in the group head, which also includes a portafilter lock and a switch to regulate boiler pressure.

Today, there are three main categories of pump-driven machine: semi-automatic, automatic and super-automatic.

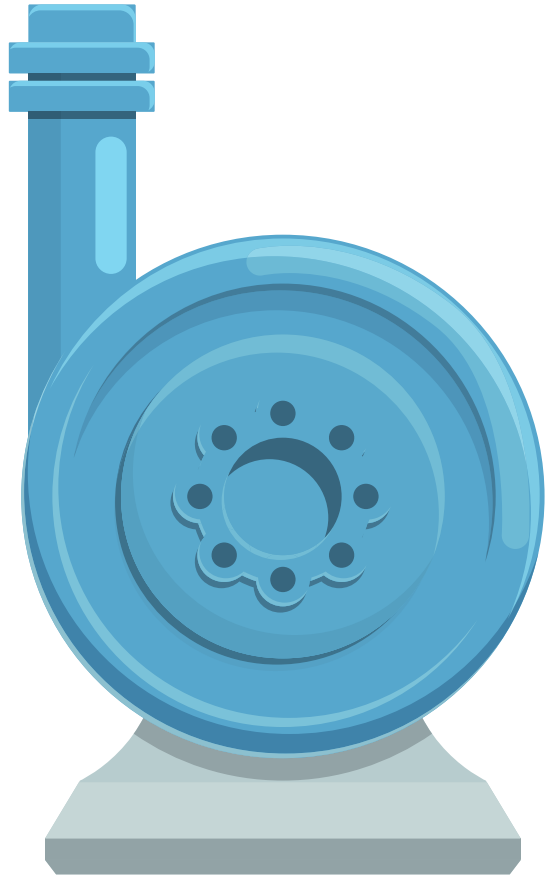
Within each there are variations including types of pump, number of boilers, and computer-aided programming.



Pump Driven Machines

Pump-driven espresso machines have been around since the 1960s and dominate the market.

They work by using an electronic pump to drive pre-heated water through the brew chamber and into a bed of coffee. With an electronic pump, it is easy to achieve consistent high pressure.



Semi-Automatic Machines

Semi-automatic machines use an automated system to drive the water through the group head. Grinding, tamping, and control of extraction time are the responsibility of the barista.

They are a good compromise between human control and mechanized consistency. You're in charge of the shot, but the water pressure and temperature are regulated.





Automatic

These are very similar to semi-automatic machines, but they automatically stop the flow of water. This ensures consistent volume in each shot and means you don't have to stand over each espresso to stop overflow. These are well suited for cafes.



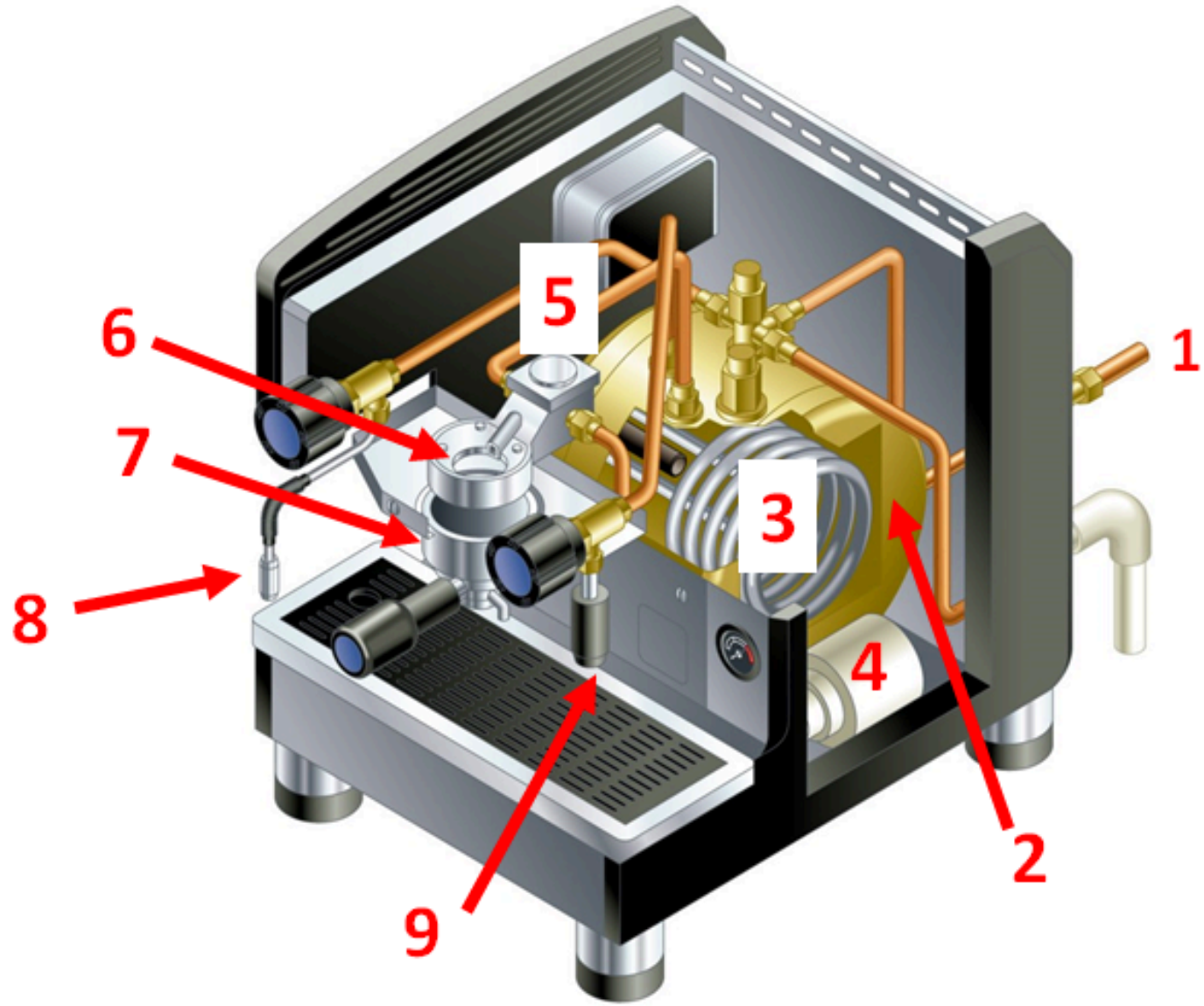
Super Automatic

Super-automatics do it all. The machine grinds the beans and measures, fills and tamps the grounds into the portafilter. Press a button and get a consistent shot every time.

Some machines let you make adjustments to grind size and timing, but there is little room for creativity. They tend to be used in homes and offices, rather than coffee shops.

Components of an Espresso Machine

1) Water Supply
2) Reservoir
3) Heating Coils
4) Pump
5) Distribution Lines
6) Group Head
7) Espresso Basket
8) Steam Arm/Wand
9) Hot Water Dispenser





Part Three

How water quality impacts espresso

Espresso is 98.3% Water

Baristas have long known about the importance of water for great espresso. If the mineral content is too high, or even too low, or if the water is high in chlorine, espresso won't have the proper flavour or aroma.

And since brewers operate at high temperatures, scale will build within the boilers and clog or reduce the life of the equipment.

According to The Specialty Coffee Association

Attribute	Specification
Turbidity	Must not exceed 0.5 NTU's
Taste/Odour	Free from off-tastes and odours
Total Chlorine	<0.05 ppm
Iron	Not more than 0.25 ppm
Total Alkalinity	Not more than 100 ppm
Total Hardness	17 - 85 ppm (1 - 5 grains)
Total Dissolved Solids	70 - 200 ppm
pH	6.8 - 7.4

Dirt particles and other small solids create a variety of problems in the espresso equipment.

The solids can clog small orifices and solenoids. They also provide the basis for mineral scale formation.





Just as a snowflake is formed around a nucleation site, mineral scale also needs a starting point.

A substantial amount of what we call mineral scale is actually dirt particles that are present in untreated water and captured in between the minerals as they precipitate.



Dissolved Solids or minerals (calcium, magnesium, iron, etc.) ***precipitate out of water*** when it is heated. This process is referred to as the development of mineral scale.

Scale insulates heating elements and fire tubes, coats submerged control sensors, clogs control valves and pipes.

The Perils of Mineral Scale

Layers of scale inhibit the heat transfer from the elements or tubes to the water supply, and slowly destroy the metals in these components.

Scale removal requires considerable effort to open the boiler and remove the scale and finish the process with the use of harsh chemicals.

These deliming agents can also eat away layers of metal in the process.



Chemicals that are added to water for disinfectant purposes are no longer needed in water for espresso.

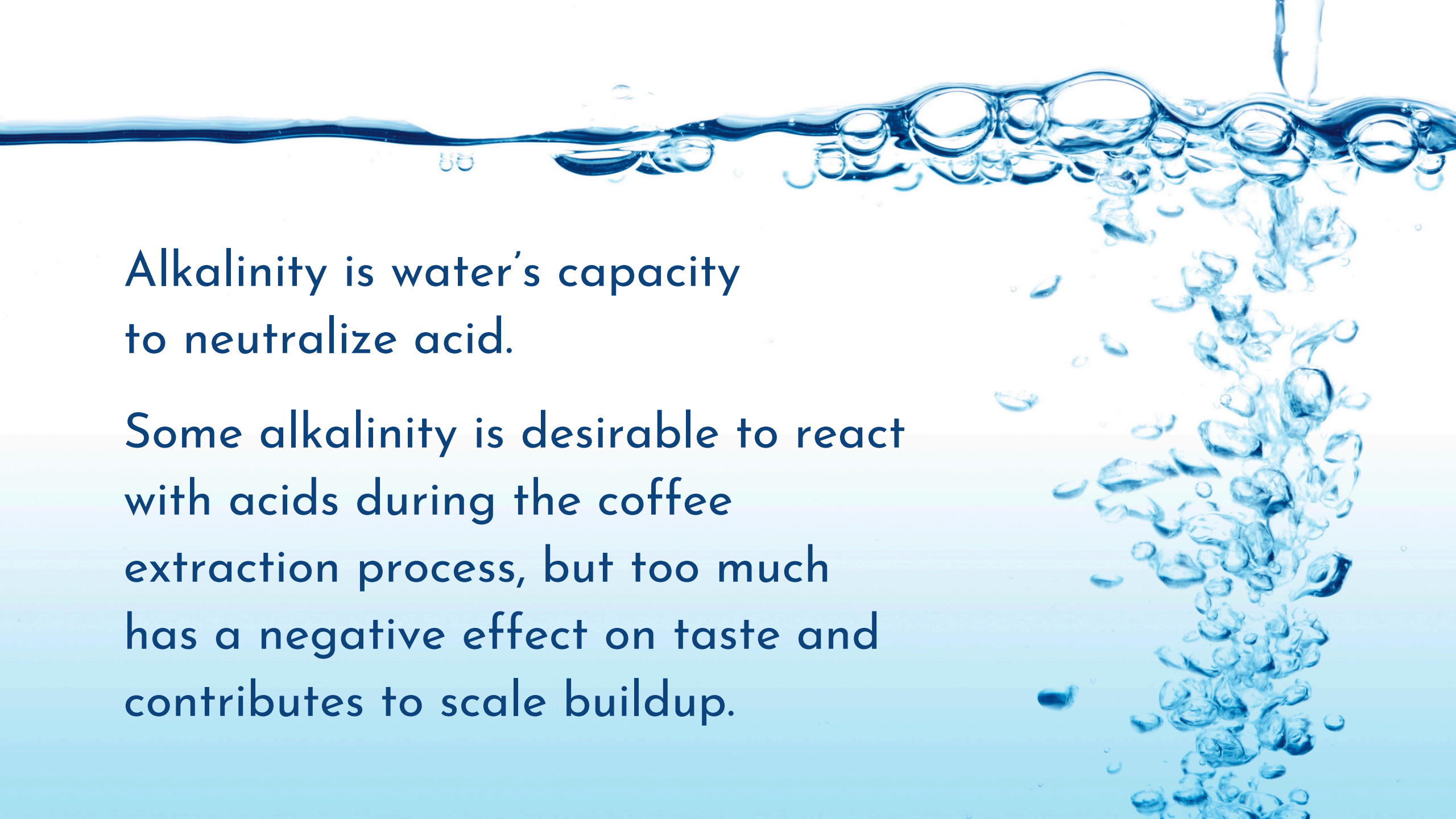
When water containing high levels of oxygen, chlorine, chloramine, chlorides (or other acidic conditions) is heated, the resulting gases can rapidly corrode the boiler shell.

The ideal water for espresso has a TDS of 90-150 ppm, with no extraneous odours or flavours that would interfere with taste, but still has enough TDS that the minerals in the water are able to help do the work of extraction.



Total Dissolved Solids

- Low TDS water causes too many coffee oils to be released, resulting in a bitter, oily flavor.
- High TDS water causes too few coffee solids and tea flavonoids to be released, resulting in weak flavor.
- Excessive TDS water causes scale build-up and corrosion in equipment resulting in costly repairs and downtime.
- High chloride and sulfate levels are detrimental to coffee balance and flavor and can be corrosive, even to stainless steel equipment.



Alkalinity is water's capacity to neutralize acid.

Some alkalinity is desirable to react with acids during the coffee extraction process, but too much has a negative effect on taste and contributes to scale buildup.

pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral.

A pH of less than 7 indicates acidity, whereas a pH of greater than 7 indicates a base or alkaline.

The pH of water is a very important measurement concerning water quality.



Alkaline verses Alkalinity...

Do you ever get confused between these two terms? They sound so similar it's easy to assume they are the same thing.

An alkaline solution simply means it has a pH greater than 7. Alkalinity, on the other hand, refers to a solution's quantitative ability to neutralize an acid.

Therefore, you can have water with high (alkaline) pH and low alkalinity, or high alkalinity and low pH.

RECAP



The financial impact of machine downtime, repairs and full replacement can be burdensome to operators.

Unplanned costs and time-consuming repairs, especially during peak operating hours, can negatively impact business.





Providing quality watercare solutions help lower the impact of most of these problems by providing lower operating costs, promoting long equipment life and serving great tasting espresso.

The result is both happy operators and satisfied customers.

This concludes this module.

Thank you for your time!

