3. COFFEE ROASTING

3.1 Introductory information

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EQUIPMENT WARM-UP

- Preheat the roaster before roasting for 30 to 60 minutes.
- Warm-up profile (warm-up at low and high power, with closed and open airflow)
- The roaster goes to its operating mode at cycle 3-5
- It is better to take simple coffee with low density for your first roasting
- "Warm-up roast profile" +15-30% to standard modulation in Pa

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STAGES OF COFFEE ROASTING

1. Loading coffee
2. Stage 1 (green)
3. Turning point
4. Stage 2 (yellow)
5. First crack
6. Development (time, %)
7. Drop
8. Second crack
9. Cooling

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3. COFFEE ROASTING

3.2 Coffee loading

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WHAT INFLUENCES:

- DROP TEMPERATURE
- MODULATION INTENSITY DURING LOADING
- BETWEEN BATCH PROTOCOL

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WHAT IT AFFECTS:

↘ ROASTING INTENSITY

Fast, normal, slow

↘ FRUITY

Strecker degradation: higher loading makes coffee fruitier

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WHAT'S HAPPENING:

ENDOTHERMIC REACTION

Energy absorption

COLOR CHANGE

From green to pale green

WATER HEATING

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RECOMMENDATIONS

FOR INTENSE ROASTING

High charge temperature

FOR SLOW ROASTING

Low charge temperature

The mismatch between temperature and intensity will require drastic changes iin the process

LOADING SIZE

Batch size

↘ BURNER'S POWER, ITS EFFICIENCY – BTU

Lack of power will result in a drawn-out roast profile.

CONDUCTION ROASTERS

cope with 60-80% of the declared volume

CONVECTION ROASTERS

can handle 100% of the declared power

LOADING SIZE

Batch size

↘ LOCATION OF SENSORS

If there is too little coffee, less than 30%. The bean will not be caught by the temperature sensors, and the logger will record irrelevant information.

↘ TOO MUCH COFFEE

There will not be enough energy for roasting, the too long profile, and coffee may fly out into the airflow pipe.

BTU (BritishThermal Unit) is a unit of measurement unit for thermalenergy, it is defined as the amountof heat requiredto raise the temperature of one poundof water by one degree Fahrenheit (11,000 BTU per kilogram, or 3.2 kWh per 1 kg)

POWER MODULATION OPTIONS AT START

ON THE DECLINE

for medium and long roasting profiles

- heat the air inside the drum above the charge temperature reduce power
- wait until the temperature goes from top to bottom - load at the desired degree

AT THE RISE

for roasters with high % of convection

- perform protocol between roasts, cool air inside the drum
- set the modulation to the required power - load the beans at the moment when the temperature reaches the required one from bottom to the top

ON "EQUILIBRIUM"

for roasters with a high percentage of conduction

- select the power at which, after completing the protocol between roasts, the temperature will smoothly reach the desired degree and stop at it in balance

3. COFFEE ROASTING

3.3 Stage 1 (green)

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WHAT INFLUENCES:

- **TIME TO PASS THE STAGE**
- **TURNING POINT**
  Time, temperature
- **MODULATION AIRFLOW**

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WHAT IT AFFECTS:

- ↘ **MOISTURE EVAPORATION INTENSITY**
- ↘ **UNIFORMITY OF ROASTING**
  Gradient
- ↘ **INTENSITY 1st CRACK**

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WHAT'S HAPPENING:

- **ENDOTHERMIC REACTION**
  Energy absorption
- **COLOR CHANGE**
  From green to pale green
- **WATER HEATING**

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3. COFFEE ROASTING

3.4 Turning point

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WHAT INFLUENCES:

↘ BETWEEN BATCH PROTOCOL/ "MORNING WARM-UP"

↘ LOADING VOLUME

Large % of the drum size - the turning point will be lower

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HOW TO ANALYZE THE PASSAGE OF THE TURNING POINT

CHARGE TEMPERATURE

- We select it based on our roasting style and dynamics. On average, it is 200 degrees +-20 with individual physical characteristics of the beans..

RATE OF TEMPERATURE RISE (ROR)

- Once the turning point is reached, ROR begins to grow smoothly and we see the peak of ROR. This is a signal for us - one of the three - about hitting the benchmark.

AIR TEMPERATURE

- This is the value that first signals to us that we have reached the standard, and if we see its deviations, the other parameters will follow it up too.

BEAN TEMPERATURE

- The bean temperature graph, when it hits the standard at the turning point, it doesn't guarantee us an ideal profile at further stages, but is the most important control point. Deviations can be due to an unheated roaster, denser or moist bean, or a burner modulation error.

WHAT IT AFFECTS:

↘ **OVERALL DELTA OF THE ROASTING PROFILE**

The extreme lower and upper point of the graph

↘ **HITTING THE REFERENCE PROFILE**

WHAT'S HAPPENING:

↘ **START OF ROR GRAPH**

↘ **STABILIZATION OF THE TEMPERATURE**

beans (room temperature)
and temperature sensors

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RECOMMENDATIONS

When does it happen? At about 1st minute of roasting

TOO EARLY

Much less than 1 minute

↓

The roaster is overheated, risk of scorching, roasting profile is too short

TOO LATE

Much more than 1 minute

↓

Roaster is not heated enough, load is too big

3. COFFEE ROASTING

3.5 Stage 2 (yellow)

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WHAT INFLUENCES:

- **TIME TO COMPLETE THE STAGE**
- **ENERGY**
  Heating, reaction intensity

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WHAT IT AFFECTS:

↘ BODY

Long yellow - the body is full,
short yellow - lighter.

↘ SWEETNESS

↘ BITTERNESS

Long yellow - higher bitterness,
short yellow - lower.

WHAT'S HAPPENING:

- **MAILLARD REACTION**
- **CARAME-LIZATION**
- **STRECKER DEGRADATION**
- **COLOR CHANGE**
  From green to yellow

RECOMMENDATIONS

Yellow stage time: short/long

TOO SHORT

Body is light, "coffee bouquet" is not formed

TOO LONG

Bitterness is high, body is full

3. COFFEE ROASTING

3.6 First crack

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WHAT INFLUENCES:

↘ ROASTING INTENSITY

Intense crack increases bean size, increasing extractability.

↘ BEAN MOISTURE

The more humidity, the more intense the crack can be.

↘ STAGE 1

Green, the longer the first stage, the less active the crack will be due to the lack of residual moisture.

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WHAT IT AFFECTS:

↘ INCREASING BEAN SIZE

↘ INCREASED EXTRACTIVITY

WHAT'S HAPPENING:

↘ **THE PRESSURE INSIDE THE BEAN INCREASES**
Steam, carbon dioxide

↘ **EXOTHERMIC REACTION**
Release of energy

↘ **CLICKING SOUND**
Like popcorn

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RECOMMENDATIONS

Crack intensity: weak/too active

WEAK → Low ROR before the 1st crack, not enough energy in the beginning/middle of roasting, stage 1 is too long, low bean moisture.

TOO ACTIVE → High ROR before the crack, too much energy in the beginning/middle, short development, underdeveloped bouquet.

3. COFFEE ROASTING

3.7 Development

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WHAT INFLUENCES:

- ↘ ROR
- ↘ ROASTING INTENSITY
- ↘ TIME OF DEVELOPMENT
- ↘ % DEVELOPMENT

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WHAT IT AFFECTS:

↘ BALANCE OF TASTE

Bitterness/sourness/sweetness

↘ COLOR

Level of caramelization

WHAT'S HAPPENING

at increasing development time:

↓ **ACIDITY (CHARACTER) DECREASES**

↑ **BITTERNESS GROWS**

↕ **SWEETNESS INCREASES, THEN DECREASES**

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RECOMMENDATIONS

Development time: short/long

TOO SHORT

Acidity is high, bouquet is undeveloped, “green” (peas, vegetables)

IT'S TOO LONG

Bitterness is high, loss of flavor oils (character)

AUTOPYROLYSIS

What is it and how to avoid it?

- is a process in which the beans are spontaneously overheated, causing the organic compounds to break down, giving the coffee an unpleasant, harsh taste.

To avoid this, gradually reduce the heat a few minutes before the end of the roast, avoid sudden temperature changes, and increase the airflow. If you control the time after the first crack, you will avoid autopyrolysis and get a clean, rich taste.

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HOW TO MANAGE THE FINAL STAGE

Angle of attack ROR (rate of temperature rise) - moderate, closed or smoth.

TEMPERATURE GRAPH ANGLE AFTER THE START OF THE 1ST CRACK	ROR AFTER 1st CRACK STARTS	DEVELOPMENT	BALANCE
Moderate	7	Normal	Bitterness/Acidity Balance
Acute	5	Short	Risk of “undevelopment”
Smooth	10	Long	Risk of “overdevelopment”

PERCENTAGE OF DEVELOPMENT AND ITS ROLE

The development percentage is the ratio of the time after the first crack to the total roasting time. Overdeveloped coffee is coffee with reduced acidity, duller, probably with a more pronounced group of caramelization flavors.

Overdeveloped and overcooked are not the same thing.

12-15%
FILTER COFFEE

15-17%
ESPRESSO

3. COFFEE ROASTING

3.8 Drop

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WHAT INFLUENCES:

↘ **DROP TEMPERATURE**

↘ **TEMPERATURE INCREASE**
after 1st crack

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WHAT IT AFFECTS:

↘ BALANCE OF TASTE

Bitterness/sourness/sweetness

↘ COLOR

Level of caramelizing

WHAT'S HAPPENING

- ↘ ALL PROCESSES ARE TERMINATED
- ↘ COOLING STARTS

RECOMMENDATIONS

Drop: low/high

TOO LOW

Acidity is high, undeveloped, light

TOO HIGH

Bitterness is high, loss of flavor and aromatic oils, dark

3. COFFEE ROASTING

3.9 Cooling

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WHAT INFLUENCES:

- **ROOM TEMPERATURE**
- **AIRFLOW COOLER CAPACITY**
- **COOLING TIME**
- **MIXING PROFILE**
  Number of turns
- **CLEANLINESS OF EQUIPMENT**

WHAT IT AFFECTS:

↘ **RISK OF «OVERDEVELOPMENT»**

↘ **RISK OF BAKING**

due to the contact of beans with each other

WHAT'S HAPPENING

↘ **THE PROCESSES IN THE BEAN ARE COMPLETED**

↘ **THE TEMPERATURE IS DROPPING**

up to 30-40°C in less than 300 seconds

RECOMMENDATIONS

Cooling time: long/normal

LONG

↓

1. Reduce the room temperature
2. Direct additional cooling to the cooling bin
3. Adjust the frequency and number of turns of the cooler blades
4. Clean the cooler screen/pipe