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THE ANTI-THEORY OF HOMOGENEOUS EXTRACTION

The Thermal Revolution of Espresso

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NAVIGATION GUIDE

Abstract

This work dismantles one of the most deeply rooted beliefs in the world of espresso: the idea that extraction is homogeneous. We have confirmed that:

HOMOGENEOUS EXTRACTION DOESN'T EXIST — AT LEAST, NOT IN ESPRESSO

Through a series of experiments involving 79 documented extractions, and by measuring the temperature inside the coffee puck second by second, we discovered something so surprising it was hard to accept:

THE LOW THERMAL CONDUCTIVITY OF COMPACTED COFFEE PREVENTS THE EXTRACTION FROM BEING HOMOGENEOUS THROUGHOUT THE ENTIRE PUCK

During approximately half of the extraction time, we observed significant thermal differences between the top and bottom of the coffee puck. This was not a one-off anomaly, but an internal thermal pattern: repeatable and measurable.

This finding has profound implications: for espresso machine and accessory design, for how we teach espresso preparation, and for the way we understand extraction itself.

And honestly, we still find it hard to believe.

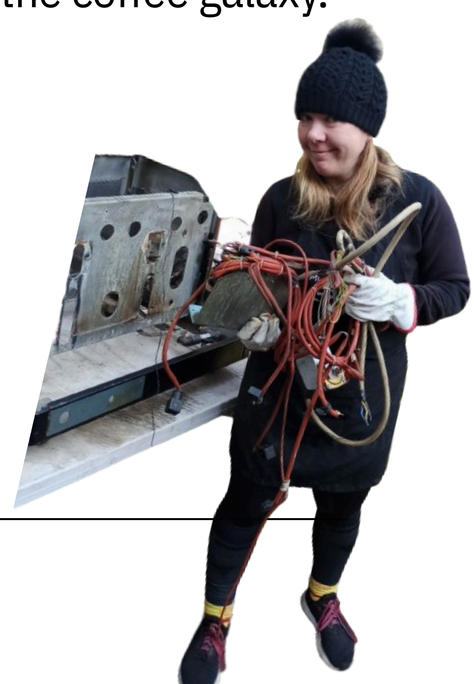
A Love for Espresso

Of all brewing methods, espresso is the one that fascinates me the most. It's a complete enigma. I believe I understand only 1% of what espresso truly is. And with this new ***anti-theory*** we've developed, maybe — just maybe — we've gotten 0.1% closer to understanding it.

Trying to understand espresso without understanding how an espresso machine works is simply impossible.

Espresso machines are my passion — a passion that keeps growing day by day. I truly believe that if you want to learn something deeply, you have to teach it. And that's exactly what we did.

In 2018, we started reviewing espresso machines on our YouTube channel: Club Amantes del Café. From the very beginning, our goal was to learn how to create the best reviews and investigations of espresso machines and grinders in the whole wide world, across the universe, and beyond the coffee galaxy.



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Our Philosophy as Reviewers

We pursued three clear goals:

1. Help people make informed decisions

Not decisions based on marketing — but on knowledge. We are *anti-consumerist, anti-advertising, and anti-marketing.* We don't believe anyone should buy a coffee machine just because a famous barista said, "It's my favorite" without giving a single argument.

We show the pros and cons of each machine without idealizing. We know there's no such thing as a perfect product — and coffee lovers know it too. What they're looking for, time and again, is honest reviews: ones that mention both the strengths and the limitations of a product. And from there, each person evaluates: Am I willing to live with these downsides? Or would I rather invest a bit more to avoid the ones I'm not prepared to deal with?

Let me say it again: We provide tools so that each person can make their own decision based on analysis — not on advertising.

2. If someone has already bought the machine, we help them get the most out of it.

We share tips and anything that can help them achieve consistent and satisfying results.

3. Help manufacturers improve their products.

A few simple modifications can make a big difference.

We know that not all coffee lovers need to understand espresso theory — in fact, very few of us actually enjoy researching it.

An entrepreneur just needs their machine to work well and produce acceptable drinks. And a home enthusiast wants a machine that makes them feel like they've brought the coffee shop into their own kitchen.

99% of coffee lovers will never be interested in the science behind espresso. And they don't have to be. Most people don't want to study thermodynamics or understand temperature curves. They just want to turn on the machine and enjoy a good espresso.

That's why I always say: the primary responsibility of the manufacturer is to design a coffee machine that doesn't depend on the user's technical knowledge.

I myself am completely inexperienced in other areas — for example, cars. I'm not a mechanic (at least not yet). I have no idea what's going on under the hood. I just want the car to take me from point A to point B — and not have a visible button that, by accident, lets me drain the gas tank.

The same should happen with an espresso machine. No machine should have functions or design details that allow the user — even unintentionally — to ruin the preparation.

On the contrary, a well-designed coffee machine should think for the user, anticipate mistakes, and help them achieve decent results — even with little experience.

In other words: **a good espresso machine shouldn't require technical knowledge — it should compensate for the lack of it.**

If someone falls in love with the process later on — welcome to the club. But for the vast majority, espresso shouldn't feel like an exam. It should be a small, everyday victory.

And precisely because of that, when we review a coffee machine, we look beyond whether it "works" or not. We pay attention to whether there are functions that are unnecessary, confusing, or make the user feel clumsy. Or, on the flip side, we look for what small adjustment — what extra detail — could make a coffee lover feel happy, proud, and supported by their machine.

Because if a coffee machine can do that... then it's truly worth it.

Our foundation is evidence. Everything we say is backed by experiments. And we always make it clear: "This is what we believe today, based on what we know now. If we discover something new tomorrow, we'll change our minds."

It was important to say all of this before getting into the theory — or rather, the **anti-theory.**

What is the temperature that really matters in espresso?

I. What Matters in an Espresso Machine?

Espresso machines have two main functions:

1. To brew espresso
2. To steam and texture milk — but today, we're not here to talk about milk.

When it comes to espresso, there are two factors that depend directly on the machine and have a direct impact on flavor:

1. Water temperature
2. Pressure — and today, we're not here to talk about pressure either.

II. Espresso Machine and the Temperature of the Water Coming Out of the Group Head

There are two main types of espresso machines on the market:

1. **Heat Exchanger Coffee Machines (HX):**

In this type of machine, the temperature of the water coming out of the group depends mainly on two factors:

1.1 The temperature of the water in the steam boiler

1.2 The temperature inside the heat exchanger

2. **Multi-boiler Coffee Machines (MB):**

In this type of machine, the temperature of the water coming out of the group depends mainly on:

2.1 The temperature of the water in the brew boiler (the boiler dedicated to the group)

But lately, I've become obsessed with one idea:

UNDERSTANDING: WHAT IS THE ACTUAL TEMPERATURE OF THE WATER WHEN IT REACHES THE COFFEE PUCK?

Because that temperature should be different from the one inside the heat exchanger (in the case of HX machines) or the brew boiler (in multi-boiler machines).

There's a 3–4 kg group that absorbs heat. There are metal parts in the portafilter that also draw temperature. And many other factors that affect the heat along the way.

The irresistible urge to answer this question led us to what we now consider a major discovery: our ***anti-theory of homogeneous extraction.***

Primary tool

To measure the temperature inside the coffee puck, we obviously needed the right thermometer. We began researching the thermometer market. We tested every model we could find, but none of them worked. We spent a small fortune until we found the perfect thermometer — the one that has now become our loyal companion.

Since espresso is a fast extraction, we needed an ultra-fast response sensor, capable of registering changes almost in real time. And finally, we found it.

The next challenge was to insert a thermocouple into the portafilter basket. We built dozens of prototypes. In the end, we decided to use a naked portafilter and drill a hole in the basket. Through that hole, we inserted the thermocouple. But there was still one problem left: sealing the hole in a way that would prevent depressurization during extraction.

Since the pressure inside the basket is extremely high, every attempt failed. Until, after many trials, we finally found a type of liquid metal that worked perfectly. Thanks to that tool, our reviews reached a whole new level. And thanks to that tool, our ***anti-theory*** was born.

Why is the temperature line curved instead of flat?

We were conducting a technical investigation — and at the same time, a review — of the **Eureka Constanza R** espresso machine. But this time, we wanted to go further. We didn't want to be just YouTubers making good reviews anymore. We aimed to position ourselves as independent researchers, capable of generating relevant, valuable data for the industry. And this investigation was, for us, a demonstration of what we're capable of. Proof that our work has value — and deserves to be compensated.

That's why we didn't want a single detail to slip through the cracks.

To deeply understand the thermal behavior of espresso in the Eureka Constanza R, we carried out 79 documented extractions (though in reality, there were many more). We recorded every parameter — including the temperature inside the coffee puck, second by second — in an Excel spreadsheet.

From that data, we built graphs. The one that matters most for our ***anti-theory of homogeneous extraction*** is the one that shows the temperature evolution over time inside the coffee puck.

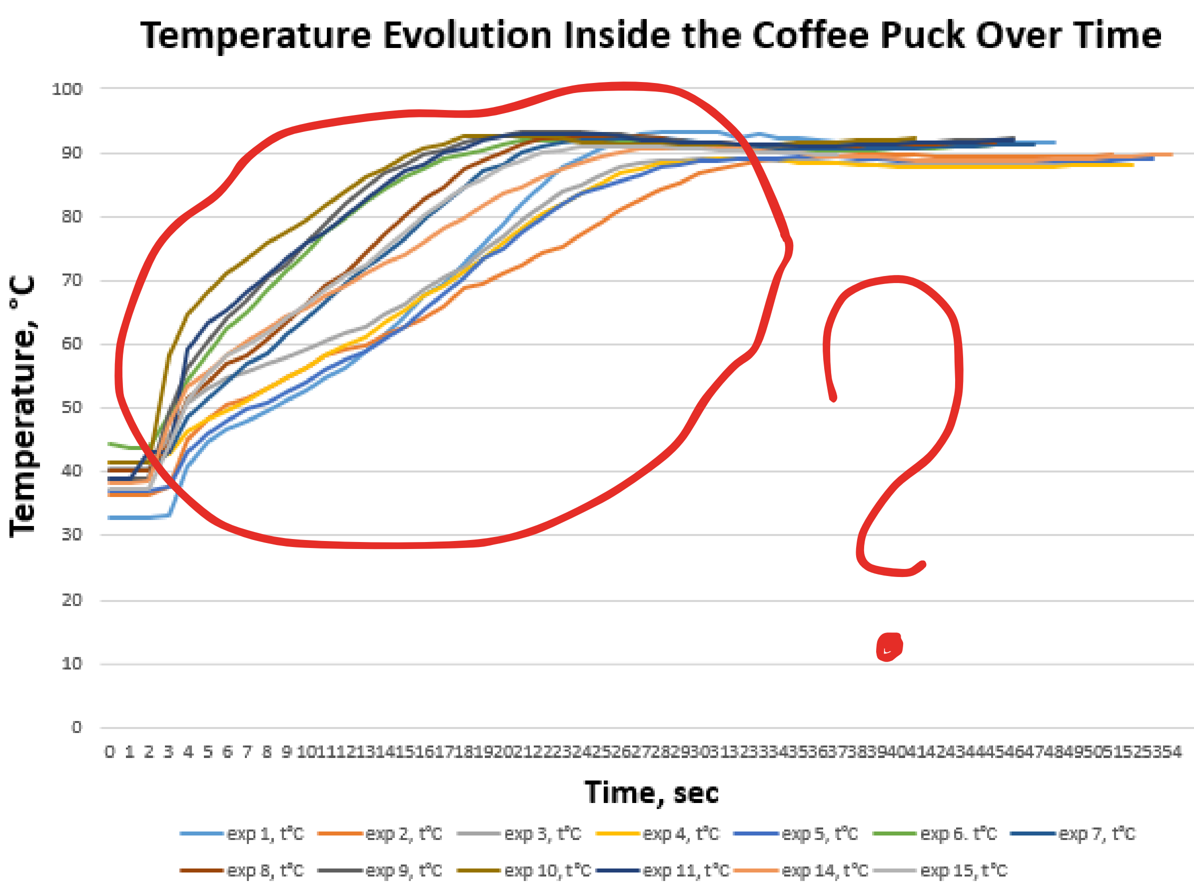
We create these graphs to understand which factors generate the thermal pattern — and which factors cause an extraction to deviate from that pattern.

This allows us to:

1. Understand how to replicate a good espresso, and
2. Know what to avoid in order to stay within the ideal thermal profile.

But there were two things I couldn't figure out:

1. Why does the temperature curve rise gradually during the first half of the extraction, instead of starting flat and remaining stable?
2. And why, even when the conditions in many experiments were practically identical, did the temperature curves never fully match during the first half of the extraction?



Graph 1: Temperature Evolution Inside the Coffee Puck Over Time

And that frustrated me. We came up with many hypotheses — none of them held up under experimentation. Until Pancho said:

> "WHAT IF IT'S BECAUSE OF THE POSITION OF THE THERMOCOUPLE TIP INSIDE THE COFFEE PUCK?"

We decided to test it.

Experimental Setup and Procedure

Testing "Pancho's Hypothesis"

To test Pancho's hypothesis — that the position of the thermocouple inside the coffee puck influences the thermal profile of the extraction — we designed a series of experiments to measure the temperature at three specific points within the puck: the top, the center, and the bottom.

Why didn't we use 3 sensors at the same time?

We didn't drill the basket in three points for two main reasons:

1. The coffee puck would have contained too much foreign material, which could have affected the flow and the quality of the extraction.
2. Three holes would have significantly increased the risk of depressurization in the portafilter, compromising the integrity of the data.

So how did we do it?

We decided to perform three separate extractions — but treat them as if they were one single extraction — replicating the exact same conditions in each, except for the position of the thermocouple.

Controlled variables in each series:

1.The time between extractions was always the same.*

2.The time between the cleaning purge and the start of the extraction was also the same.*

*This ensured that the water entering the heat exchanger had the same amount of time to heat up.

3.Each extraction yielded 60 grams.

4.The coffee dose was 18 grams.

5.Although total extraction time varied slightly, this did not affect the conclusions, since the variable measured was temperature over time.

6.During extraction, the boiler did not refill with water.

7.The portafilter spent the same amount of time inside and outside the group before each extraction.

What did we change?

Only one thing: the position of the thermocouple inside the coffee puck.

Thermocouple Position:

First extraction: thermocouple placed at the bottom of the coffee puck

Second extraction: thermocouple placed at the center of the coffee puck

Third extraction: thermocouple placed at the top of the coffee puck

Temperature Modes Used

Since the Eureka Constanza R has three thermal modes:

- W (Warm)
- H (Hot)
- VH (Very Hot)

We repeated the same three-extraction setup for each mode, resulting in three experimental series:

- Series 1 – shows the puck temperature in Mode W
- Series 2 – shows the puck temperature in Mode H
- Series 3 – shows the puck temperature in Mode VH

Important Note on the Experimental Approach

Let me emphasize something important. Although we performed nine independent extractions, they should actually be understood as three extractions divided into layers.

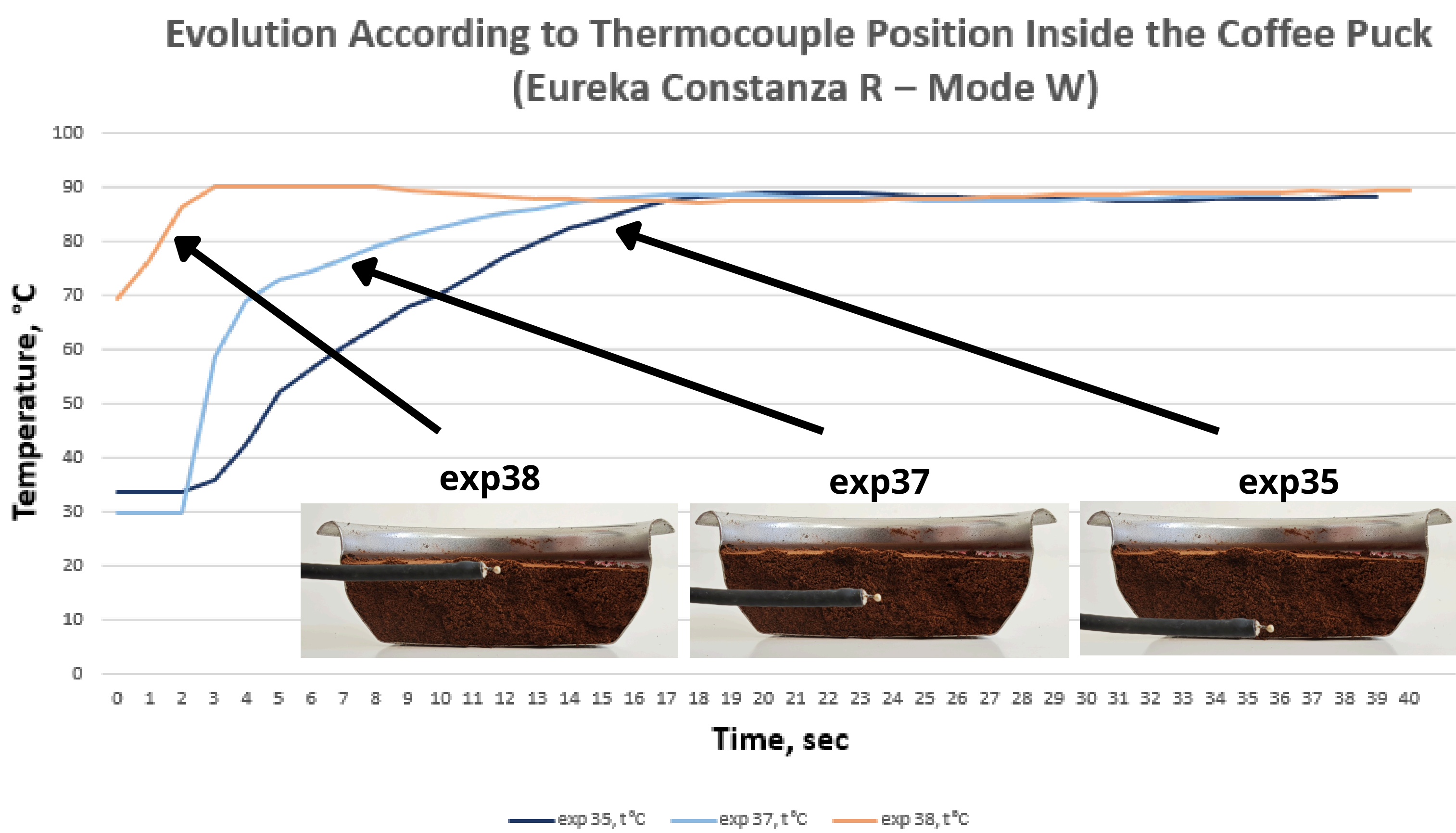
- Extractions 35, 37, and 38 represent a single extraction in Mode W, with the thermocouple placed at three different depths.
- Extractions 42, 44, and 41 correspond to a single extraction in Mode H, divided into three levels.
- Extractions 50, 52, and 48 function as a single extraction in Mode VH, measured by layers.

Since we couldn't drill the basket in three points simultaneously, we opted for this experimental solution. That's why it was essential to ensure that, within each thermal mode, the conditions for each extraction were as similar as possible.

Experiment No.	Mode	Thermocouple Position
35	W	bottom
37	W	center
38	W	top
42	H	bottom
44	H	center
41	H	top
50	VH	bottom
52	VH	center
48	VH	top

Table 1: Experiment Number vs Temperature Mode (°C) vs Thermocouple Position

Graphical Analysis of the Extractions – Series 1 (Mode W)*



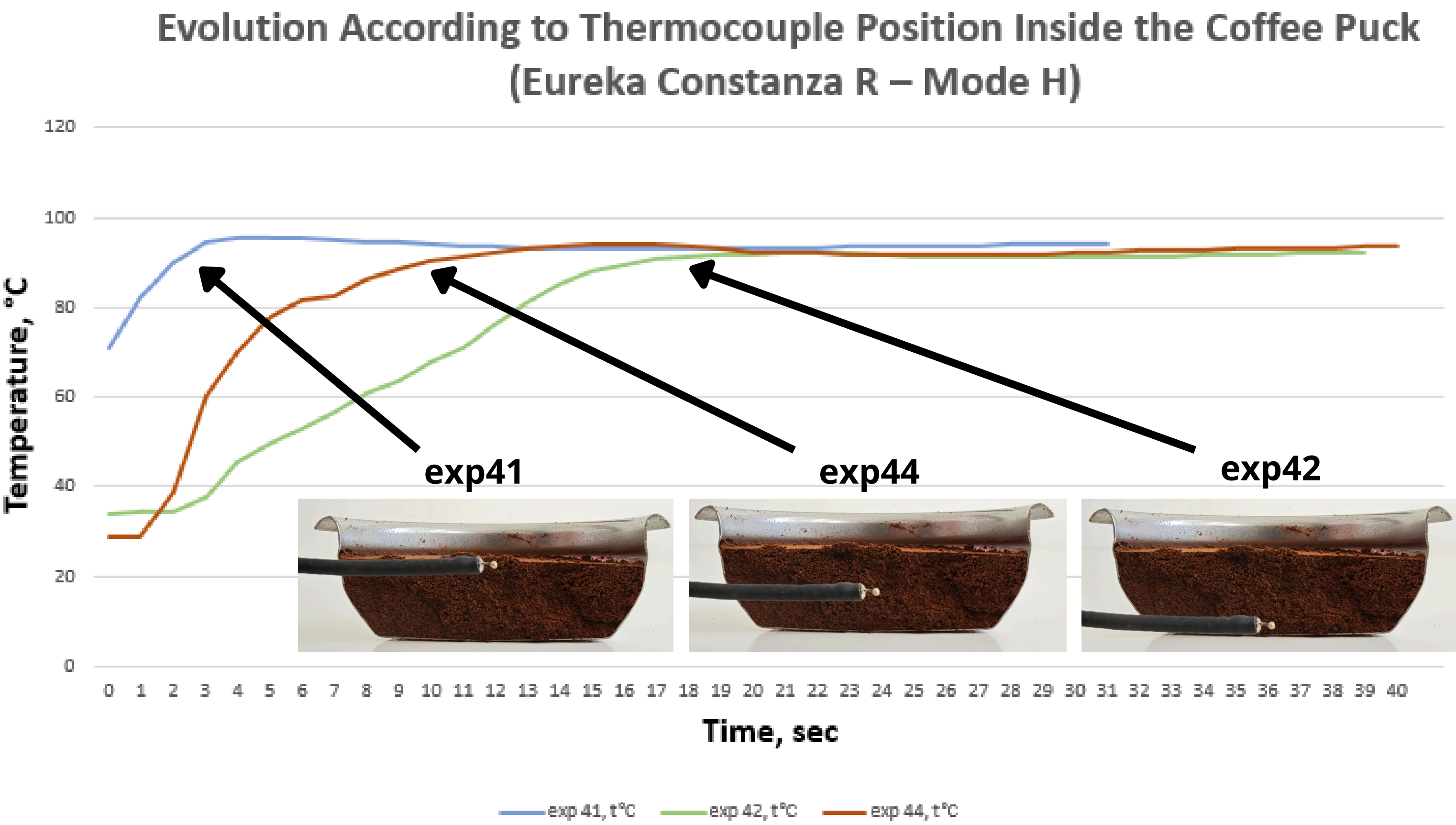
Graph 2: Temperature Evolution Inside the Coffee Puck According to Thermocouple Position (Mode W)

Preliminary Conclusions – Series 1: Mode W

The first series of experiments in Mode W confirms Pancho's hypothesis: the temperature inside the coffee puck varies depending on the position of the thermocouple. In this series, a clear thermal difference was observed between the top, center, and bottom of the puck. Full thermal alignment did not occur until second 20 of the extraction — the moment when the bottom layer finally reached its maximum temperature. This indicates that, for more than half of the extraction time, the puck operates as a thermally uneven system.

**For the full details of the data recorded in this series, see Appendix 1*

Graphical Analysis of the Extractions – Series 2 (Mode H)*



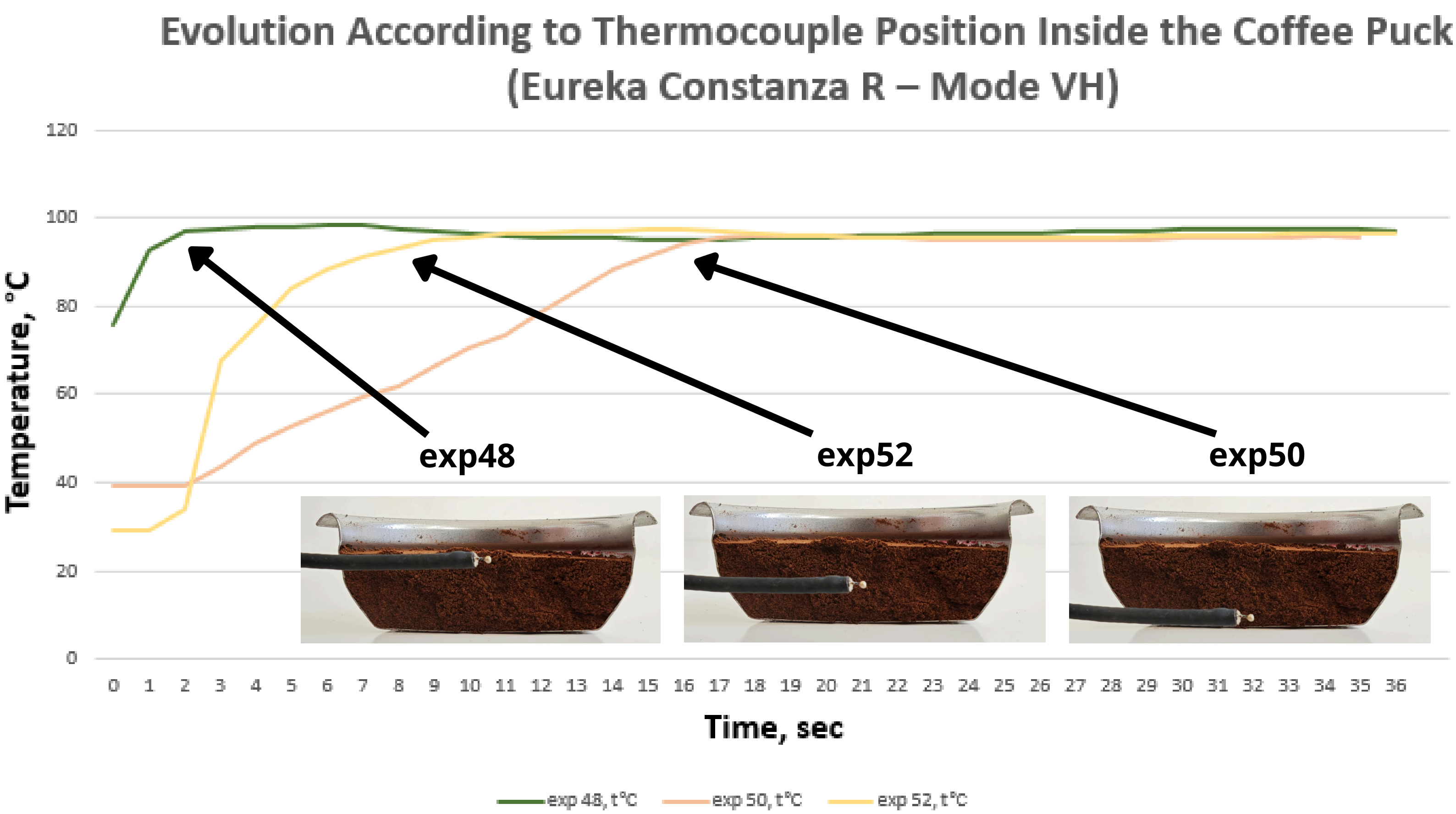
Graph 3: Temperature Evolution Inside the Coffee Puck According to Thermocouple Position (Mode H)

Preliminary Conclusions – Series 2: Mode H

The results of the second experimental series, conducted in Mode H, once again validate Pancho's hypothesis: the temperature recorded inside the coffee puck directly depends on the depth at which the thermocouple is placed. In this case, the thermal differences between the top, center, and bottom of the puck were also very pronounced. Thermal uniformity was only reached around second 22 of the extraction, when the bottom layer finally achieved its maximum temperature. This reinforces the idea that, for a significant part of the extraction, the puck behaves as a thermally unstable and transitional environment.

**The complete data corresponding to this series is available in Appendix 2*

Graphical Analysis of the Extractions – Series 3 (Mode VH)*



Graph 4: Temperature Evolution Inside the Coffee Puck According to Thermocouple Position (Mode VH)

Preliminary Conclusions – Series 3: Mode VH

In the third series of experiments, conducted under the highest thermal mode (VH), the data followed the same pattern observed in the previous series. The position of the thermocouple inside the puck determined the thermal profile. Even though the thermal energy was higher, the temperature differences between layers did not disappear. On the contrary, they remained clearly evident during the first half of the extraction. It wasn't until second 19 out of the 35-second extraction that the three internal layers of the puck reached thermal alignment, coinciding with the point when the bottom reached its maximum temperature. Even at higher temperatures, heat is not evenly distributed from the start. Once again, the puck behaves as a system of evolving thermal layers. And that makes the idea of homogeneous extraction completely unsustainable.

**You can find all the data from this series in Appendix 3*

The Anti-Theory of Homogeneous Extraction

After analyzing the data and each of the graphs, the time has come to present our ***anti-theory***:

THE EXTRACTION INSIDE THE COFFEE PUCK IS NOT HOMOGENEOUS

During the first half of the extraction, the temperature inside the coffee varies depending on depth.

Average Temperature: A Key Indicator of Thermal Non-Homogeneity

Average temperature is an excellent indicator for evaluating how thermally homogeneous an extraction is over time. And our data makes it clear: in none of the three modes (W, H, and VH) is true thermal homogeneity ever achieved. But when we analyze the average temperature only during the first few seconds of the extraction —before the temperatures begin to align— the results are even more striking.

Table 2: Average Temperature (°C), Mode W

Experiment No.	35	37	38
Average Temperature (°C) During First 20 Seconds	66,11	74,2	87,24
Average Temperature (°C) During the Entire Extraction	76,65	80,18	87,96

Table 3: Average Temperature (°C), Mode V

Experiment No.	42	44	41
Average Temperature (°C) During First 22 Seconds	68,6	80,37	92,23
Average Temperature (°C) During the Entire Extraction	78,38	85,67	92,67

Table 4: Average Temperature (°C), Mode VH

Experiment No.	50	52	48
Average Temperature (°C) During First 19 Seconds	68,68	82,76	95,35
Average Temperature (°C) During the Entire Extraction	80,58	88,82	96,06

Comparison: Average Temperature During First Seconds vs. Full Extraction

Mode W

bottom:

35

First 20 s → 66,11 °C
Full Average → 76,65 °C

center:

37

First 20 s → 74,2 °C
Full Average → 80,18 °C

top:

38

First 20 s → 87,24 °C
Full Average → 87,96 °C

Mode H

bottom:

42

First 22 s → 68,6 °C
Full Average → 78,38 °C

center:

44

First 22 s → 80,37 °C
Full Average → 85,67 °C

top:

41

First 22 s → 92,23 °C
Full Average → 92,67 °C

Mode VH

bottom:

50

First 19 s → 68,68 °C
Full Average → 80,58 °C

center:

52

First 19 s → 82,76 °C
Full Average → 88,82 °C

top:

48

First 19 s → 95,35 °C
Full Average → 96,06 °C

While I was analyzing the data and trying to understand why the temperature varied depending on the position of the thermocouple — because for me, at first, it wasn't obvious at all — several hypotheses came to mind. It's one thing to confirm that the temperature changes. But it's a very different thing to explain why.

And then, for the first time, an idea crossed my mind:
What if homogeneous extraction doesn't actually exist?
My brain rejected it immediately.

It was like suddenly finding out that Santa Claus isn't real.
As if everything I believed about espresso came crashing down.
But the data was there. And so was the logic.

Not long ago, Pancho and I had just finished watching The Big Bang Theory (I'm a fan). It was the episode where Sheldon and Amy present their theory of superasymmetry on their wedding day. I remember telling him:

"Can you imagine discovering something like that one day?"

A few weeks later, without expecting it — we did. It wasn't luck. It was obsession, critical thinking, years of testing and research. **The dream of any researcher: to discover something like this.**

Why is the extraction not homogeneous in the first half?

BECAUSE GROUND COFFEE HAS LOW THERMAL CONDUCTIVITY

I'm not a physicist — and the little I know about thermodynamics I learned in school many years ago — but I'm going to try to explain it using basic logic and real-life analogies.

If the puck had high thermal conductivity...
...then, by the time the first drop of espresso reaches the cup, the puck should already have a uniform temperature across all its layers. After all, if the first drop is coming out, it must mean — in theory — that the whole puck is wet, right? But no. Not everything that's "wet" is fully saturated.

What does it really mean to be saturated?
Let's think of something simple: When we spill water on the floor and try to clean it up with a towel. If the spill is small, the towel absorbs all of it. If the spill is large, the towel becomes saturated — it can't absorb any more, and we have to wring it out. That point — where it can no longer absorb any more liquid — that's what we call saturation.

And what does this have to do with coffee?
The same thing happens with the coffee puck. Even if the first drop is already falling into the cup, the puck saturates gradually — from top to bottom. The top layers are already saturated. The center is in the process. The bottom is still barely wet.

And water is the element that allows heat to be transferred. Without water, coffee is a very poor thermal conductor.

A better analogy? Beach sand.

Think about sand on a sunny day: the surface is hot, but if you dig just a few centimeters, it's cold underneath. Sand — just like ground coffee — has air between the particles and doesn't conduct heat well. And the coffee puck behaves the same way: without full saturation, heat has a hard time getting through.

And now, the data

Let's look at the temperature recorded at the exact second the first drop of espresso hits the cup. The difference between layers is striking.

Table 6: Temperature (°C)
Inside the Puck at the Moment the First Gram Drops – Mode W

Experiment No.	35	37	38
Temperature (°C) at First Gram in Cup	52,1	72,9	90,3

Table 7: Temperature (°C)
Inside the Puck at the Moment the First Gram Drops – Mode H

Experiment No	42	44	41
Temperature (°C) at First Gram in Cup	49,7	77,9	95,4

Table 8: Temperature (°C)
Inside the Puck at the Moment the First Gram Drops – Mode VH

Experiment No	50	52	48
Temperature (°C) at First Gram in Cup	49,1	84,1	98,2

What changes when saturation is reached?

Once water manages to fully soak the entire puck — in other words, once it's saturated: The air between the particles is displaced by water. Water allows heat to flow more efficiently. Temperature begins to equalize across the layers. Therefore, the puck's thermal conductivity increases after saturation.

Ground coffee has low thermal conductivity when dry or only partially wet, and it only improves that thermal property once fully saturated.

This isn't just about espresso...

The most revealing part is that this thermal inequality isn't exclusive to espresso. Any brewing method where water comes into contact with a compact mass of coffee could be experiencing the same phenomenon.

Conclusion: A Theory That Changes Everything

We believe our **anti-theory** challenges the most fundamental pillars of espresso: how machines are designed, how the coffee puck is formed, how pre-infusion is understood, how thermal stability is measured, and even how a "good extraction" is defined.

Everything we took for granted... no longer is. We hope that by reading this, you find yourself in the same state we were in:

IN SHOCK

But also with that spark in your heart that lights up when something big has just been discovered. Because espresso — like science — is not a perfect truth. It's a constant search.

Would you like to collaborate with us?

- If you're a ***manufacturer of espresso machines, grinders, or other coffee equipment,*** and you'd like us to test your product before launch, perform a technical analysis, or simply put it to the test — we're open to collaborating.

- We're also available for joint projects, research partnerships, or special collaborations. We love working with people who are as passionate about coffee as we are.

What if we changed the way espresso is understood — together?

- I'm currently seeking support and funding to write a book that will shake up everything we think we know about espresso. A book based on real data, independent experiments, and discoveries that —until now— no one had ever revealed.

But one thing is non-negotiable: Our absolute freedom of opinion.
If we collaborate, we will say exactly what we think. Always.

club_amantes_del_cafe Club Amantes del Café

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Appendix 1. Series 1 (Mode W)

Mode	W					
Experiment No	35 - bottom		37 - center		38 - top	
Time, sec	t°C	peso, gr	t°C	peso, gr	t°C	peso, gr
0	33,6	0	29,6	0	69,5	0
1	33,6	0	29,6	0	76,5	0
2	33,6	0	29,7	0	86,5	0
3	35,8	0	58,8	0	90,3	0
4	42,5	0	69	0	90,3	0
5	52,1	1,4	72,9	1,4	90,3	1,6
6	56,5	2,3	74,7	2,4	90,3	2,6
7	60,6	2,9	77	2,8	90,3	3,5
8	64	3,9	79	3,9	90,2	4,1
9	67,8	4,6	80,9	4,9	89,7	5
10	70,4	5,6	82,5	5,4	89,3	5,7
11	73,8	6,2	84,1	6,8	88,9	6,8
12	77,1	7,4	85,4	7,9	88,5	7,3
13	80	8,7	85,9	9,2	88,2	8,7
14	82,6	9,9	87,3	10,7	88,2	9,9
15	84,2	11,2	87,9	12	87,6	11,3
16	86,1	12,4	88,4	13,6	87,6	12,6
17	87,6	14	88,8	15,5	87,5	13,9
18	88,3	15,8	88,8	17,5	87,4	14,9
19	88,8	17,7	88,9	19,2	87,5	16,7
20	89,3	19,7	88,9	21,7	87,5	18,4
21	89,3	21,4	88,5	23,9	87,5	20,2
22	89,3	23,3	88	26,2	87,6	21,9
23	89,3	25,3	88	28,2	87,7	23,8
24	88,8	27,3	87,9	30,9	87,9	25,6
25	88,4	29	87,7	33,3	88,1	27,4
26	88,4	31,5	87,6	35,6	88,2	29,5
27	88,2	33,7	87,6	38,2	88,4	31,1
28	88	35	87,6	40,4	88,5	33,1
29	87,9	38	87,7	42	88,6	35
30	87,9	40,2	87,9	45,2	88,7	36,7
31	87,8	42,4	88	47,9	88,8	38,8
32	87,8	44,5	88,2	50,1	89	40,8
33	87,8	46,8	88,4	52,5	89	42,9
34	87,9	49	88,5	55	89	44,8
35	88	51,2	88,6	57,5	89,1	47,2
36	88,1	53,3	88,7	60	89,3	48,7
37	88,2	55,9			89,4	53,1
38	88,3	58,1			89,3	55,3
39	88,4	60			89,4	56,8
					89,4	59
					89,5	60,7

Appendix 1. Series 2 (Mode H)

Mode	H					
Experiment No	42 - bottom		44 - center		41- top	
Time, sec	t°C	peso, gr	t°C	peso, gr	t°C	peso, gr
0	34,1	0	28,9	0	71	0
1	34,2	0	29	0	82,1	0
2	34,2	0	38,5	0	90,1	0
3	37,6	0	60,2	0	94,4	0
4	45,5	0	70,1	0	95,4	2,7
5	49,7	1,4	77,9	1,2	95,4	4,3
6	53,1	2,2	81,6	1,7	95,5	5,3
7	56,4	2,6	82,7	2	95	6,8
8	60,6	3,7	86,4	3,3	94,6	8,3
9	63,5	4,1	88,5	3,6	94,6	9,9
10	67,7	5,1	90,3	4,7	94,2	11,4
11	71,1	6,1	91,2	5,1	93,7	13
12	76,1	6,9	92,3	6,3	93,7	14,1
13	81,1	8,1	92,9	7,3	93,2	15,9
14	85,3	9,5	93,4	7,8	93,2	18
15	88,1	10,8	93,8	9,2	93,2	19,4
16	89,3	12,3	93,8	10,9	93,1	21,4
17	90,9	13,2	93,8	12,4	93,1	23,8
18	91,4	15,1	93,4	14,2	93,1	26
19	91,8	17,1	92,9	16	93,1	38,6
20	91,9	19,2	92,4	18	93,1	30,7
21	92,1	21,1	92,4	19,7	93,2	33,3
22	92,2	23,5	92	21,6	93,3	36,2
23	92,2	25,4	91,9	23,5	93,5	38,7
24	91,8	27,2	91,7	25,9	93,6	41,3
25	91,4	29,8	91,6	28,1	93,6	44,9
26	91,1	32,1	91,6	30,1	93,7	47,3
27	91,3	34,1	91,7	32,3	93,8	50
28	91,2	36,4	91,8	34,6	93,9	53,6
29	91,2	38,6	91,9	36,8	94	56,3
30	91,2	40,6	92,1	38,9	94	58,3
31	91,2	42,7	92,2	41,4	94,1	60,5
32	91,4	45,2	92,7	43,6		
33	91,5	47,4	92,7	45,6		
34	91,7	49,7	92,8	47,7		
35	91,8	51,8	92,9	50		
36	91,9	54,1	93	52,3		
37	92	56,6	93,2	54,5		
38	92,2	58,8	93,3	56,6		
39	92,2	61	93,4	58		
			93,4	59,6		

Appendix 1. Series 3 (Mode VH)

Mode	VH					
Experiment No	**50 - bottom**		**52 - center**		**48 - top**	
Time, sec	t°C	peso, gr	t°C	peso, gr	t°C	peso, gr
0	39,1	0	29,3	0	75,7	0
1	39,2	0	29,3	0	92,9	0
2	39,1	0	33,9	0	97,1	0
3	43,8	0	67,5	0	97,7	0
4	49,1	1,1	75,4	0	98,2	0
5	52,5	1,7	84,1	1	98,2	1,7
6	56	2,8	88,4	2,9	98,3	2,3
7	59,6	3,7	91,3	3,4	98,3	3,4
8	61,9	4,3	93,3	4,5	97,5	4,4
9	66	5,6	94,9	5,5	97	5
10	70,4	6,4	95,7	6,2	96,5	6,3
11	73,6	7,3	96,3	7,6	96,1	7,3
12	78,6	6,6	96,7	8,7	95,6	8,8
13	83,3	10,3	97,2	10,1	95,6	9,7
14	88,4	11,8	97,2	11,6	95,4	11,3
15	91,1	13,8	97,4	12,9	95,3	13
16	93,9	15,9	97,4	14,8	95,3	14,8
17	95,6	17,8	97,1	16,5	95,3	16,6
18	96,1	20	96,6	18,3	95,4	18,5
19	96,2	22,3	96,2	20	95,6	20,4
20	96,2	24,6	96,1	22,8	95,7	22,4
21	95,7	26,6	95,7	24,7	96,2	24,7
22	95,7	29,5	95,7	26,8	96,2	26,8
23	95,3	31,9	95,6	29,5	96,3	29,1
24	95,3	34,5	95,5	31,6	96,5	31,4
25	95,2	37,1	95,5	34	96,6	34,8
26	95,1	39,3	95,5	36,3	96,7	36,7
27	95,1	42,3	95,6	39,3	96,9	39,2
28	95,1	44,9	95,7	41,6	97	41,3
29	95,3	47,2	95,8	43,8	97,2	43,8
30	95,4	49,3	95,9	45,8	97,3	46,6
31	95,5	51,6	96,1	48,3	97,4	49,1
32	95,6	54,1	96,2	50,7	97,5	51,1
33	95,7	56,2	96,4	53,2	97,5	54
34	95,9	58	96,5	55,5	97,6	56,7
35	95,4	59,2	96,6	58	97,6	58
			96,7	60	97	60