

EXPERIMENTAL STUDY OF BAKERY PRODUCTS MADE IN GAS HEATED FURNACES USING RECIRCULATING GASES

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ABSTRACT

The construction and operation of ovens used in bakery have an important role in ensuring quality in bakery. The present paper's aim is to study the bakery products obtained in recirculating gas heated furnaces in terms of the evolution of the shell hardness over the course of two days.

INTRODUCTION

The middle eastern peoples (Assyrians, Jews, and Egyptians), from the period of 2500-2000, prepared a dough with a low consistency, framed in large tanks, fermented or unfermented and dried in the form of cakes in the sun or baking (later) , in furnaces. Depending on the social condition of the consumers, the sorts of flour were established thus: the sort of wheat for the common people, the sown flour for the slaves and the fine flour, most often enriched with fruits (figs, dates) for pharaohs and clergy (Țucu 2007).

The Greeks improved bread technology by improving the quality and expanding the assortment (the historical sources name over 72 assortments (rye bread, oat, beans for the poor, dietetic bread made with honey, milk and oil for the rich, spicy bread for wine tasting, etc.), from which it was then transmitted to the Romans, who transformed the bread production into a complex process organized on several phases (buying grain, grinding with fine sifting, preparing, dividing, shaping and baking the dough and sale of bread on the basis of weighing and control), introducing the cuvette type stirrers, with the animal-driven stirrer and the masonry furnaces.

This craftsmanship did evolve much during the Middle Ages. The emergence of industrialization, overcrowded human settlements, the refining of tastes in food, made the beginning of the nineteenth century to proceed on advanced mechanization and automation of the processes of milling and bakery, to the modification of the systems and technical principles used (Țucu 2007).

In our country, the first bakery units of industrial type were built by the army (storehouses), at the end of the sec. XIX and early sec. XX, and after the First World War were founded the first large units, equipped with mixers and steam-heated furnaces (Dampf).

MATERIAL AND METHODS

In the pressure recirculation solution, the hot gases in the furnace mixed with recirculated gases are sucked by the fan 4 directly from the mixing chamber 3 and refolded to the flow divider 6. The two semi-gas streams scrub the baking chamber of the products through two sets of channels placed above and below it.

After the baking chamber has been heated, the gases are gathered in the pipe/duct 8 and brought to the distributor 10 where the amount of recirculated gas is regulated. The chimney draft is adjusted using the flap 11 from the evacuation pipe (Bâlc et al. 2013), (Bâlc et al. 2016).

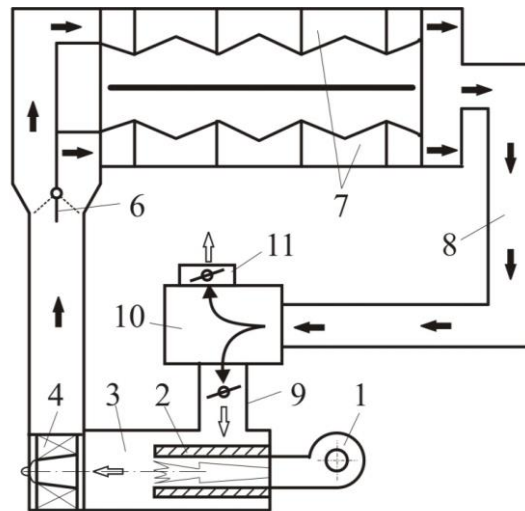


Figure 1. Forced gas circulation to gas recirculation furnaces (pressure recirculation):
1-fan injector, 2-firebox; 3- mixing chamber; 4- gas recirculation fan; 5- discharge pipes;
6- flow divider flaps; 7-baking chamber; 8- suction pipe; 9-flap that regulates recirculation flows;
10-gas distributor; 11-flap that adjusts the draft on the chimney

Due to the shape and construction of the ovens, the bread undergoing the experiments can pass through different stages of shell consistency: from semi-soft shell to rough or very hard shell (Tisan, 2009).

The tests were carried out on a sample of two loaves of white wheat flour, baked both in the electric furnace and in the traditional oven, and the measurements were made every 60 minutes for 48 hours using the Innovatest Impact TH-1100, a portable digital tester. This tester operates according to the rebound method, standardized according to ASTM A956. Its compact design allows the easy testing on components which are rather hard to carry or difficult to access surfaces by other hardness testers.



Figure 2. Innovatest Impact TH-1100 hardness tester

This hardness tester functions on different scales of hardness such as: Rockwell, Brinell, Vickers, Shore, Leeb and the results of the measurement are directly displayed on the screen of the tester. In addition, the measurement can be carried out from different angles even in difficult positions.

Other benefits of the tester include: LCD screen, battery capacity on the screen, rechargeable Li-ion battery, easy handling, no cables, and low test expenses. The following illustrations show the characteristics of the Innovatest Impact TH-1100 hardness

tester and its components. The characteristics of the Innovatest Impact TH-1100 are listed in the following table:

Table 1

Innovatest Impact TH-1100

No.crt.	Characteristics	Values
1	Measuring range	190~960 HLD
2	Measuring direction	360°
3	Hardness scales	HL, HB, HRA, HRB, HRC, HV, HS
4	Display	112x48 dot matrix LCD
5	Impact range	1~9 (optional)
6	Charger	6V/400mA
7	Work time	>8 h
8	Charging time	2~3 h
10	Dimensions	145x35x30
11	Mass	130 g.

RESULTS AND DISCUSSIONS

For testing, the hardness testing device has been set on Brinell hardness scale, one of the most common hardness testing methods used for testing materials with hardness below 350 HB.

It was determined the hardness of the upper crust bread baked in an oven heated with recirculating gas and traditional oven too.

Test results are shown in Table 2.

Table 2

The final experimental results

No. crt.	Time, τ , h	HB oven heated with recirculating gas	HB traditional oven	No. crt.	Time, τ , h	HB oven heated with recirculating gas	HB traditional oven
1	4	65	103	23	26	99	137
2	5	66	107	24	27	102	140
3	6	68	108	25	28	105	142
4	7	69	110	26	29	107	143
5	8	69	110	27	30	106	146
6	9	72	114	28	31	109	148
7	10	73	117	29	32	111	149
8	11	73	117	30	33	115	150
9	12	75	120	31	34	116	152
10	13	77	120	32	35	117	152
11	14	76	122,5	33	36	119	154
12	15	79	123	34	37	121	155
13	16	78	125	35	38	123	155
14	17	81	126	36	39	125	157
15	18	85	126,5	37	40	128	159
16	19	89	127	38	41	129	160
17	20	91	127	39	42	132	160
18	21	92	128	40	43	136	161
19	22	94	133	41	44	137	162
20	23	95	133	42	45	139	163
21	24	96	134	43	46	143	164
22	25	97	136	44	47	141	165

Figure 3 shows the evolution of bread crust hardness *make* in oven heated with recirculating gas and traditional oven.

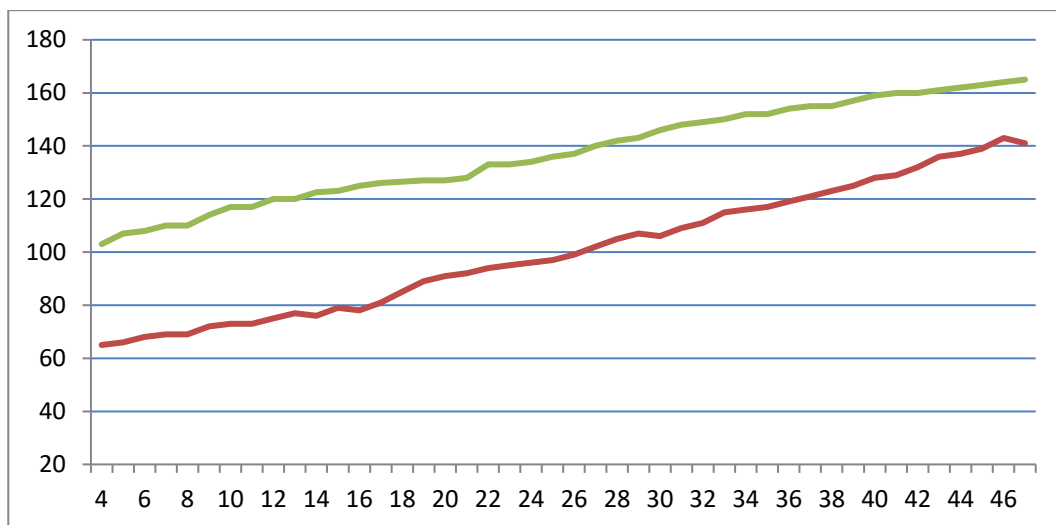


Figure3. Hardness depending on time for oven heated with recirculating gas (red curve) and traditional oven

CONCLUSIONS

As expected, the hardness of the shell of bakery products obtained in ovens heated with recirculating gas is lower than the one of the products obtained in the traditional oven.

Recirculating gas heated ovens due to the possibility of temperature control and steaming system will lead to the obtaining of superior bakery products.

Although the quality of products is not at the level of those produced in electric furnaces, the quality gap is decreasing.

Recirculating gas heated ovens still remain the most used in bakery.

The cost of the bread produced in recirculating gas heated ovens is lower than the cost of the bread produced in electric heated furnaces.

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