Research Article

Experimental Determination Of The Boiling Point Of Tomato Paste

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Abstract
The boiling point is the main indicator of the concentration of tomato paste, which characterizes the state of equilibrium of systems at certain pressures in the apparatus; at constant pressure, the boiling point of the solution depends on its concentration.
The boiling point of solutions can be determined according to Raoult's law. The boiling point of plant solutions and the vapor pressure of the solvent above it deviate from the regularities inherent in ideal solutions. Therefore, various empirical formulas have to be used for calculations. If the boiling point of the pure solvent tp is known, then the boiling point of the product can be expressed as:

1. Study of the boiling point of tomato solutions

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$$t_k = t_p + \Delta t$$

where: Δt - temperature depression.

The boiling point of a product is an important value in the design and calculation of evaporators and depends on the chemical nature of the product and the solvent; it increases with increasing concentration and external pressure on the liquid.

If the boiling point of a solution of a given concentration is known at only one pressure, then the boiling point of this solution is determined at any given pressure in the apparatus. The calculation is made according to the Babo rule:

$$\left(\frac{P_{p1}}{P_1}\right)_t = \left(\frac{P_{p2}}{P_2}\right)_t = const$$

where: Pp1, Pp2 - saturated vapor pressure of the solution at different temperatures;
P1, P2 - saturated vapor pressure of a pure solvent at the same temperatures.

Babo's law is applied for low concentrations of tomato paste, and for concentrated tomato paste, the amendments established by V.N. Stabnikov are applied.

The boiling point of a solution at various pressures can be determined by the linearity rule of chemical and technical functions: the ratio of the difference between the boiling points of a liquid $\left(t''_{жс} - t'_{жс}\right)$ at two arbitrary pressures to the difference between the boiling points of another liquid $\left(t''_{в} - t'_{в}\right)$ at the same pressures there is a constant value. Water is the second liquid for which boiling points at various pressures are known.

2. Description of the experimental setup

A schematic of the experimental setup for determining the boiling point is shown in Fig. 1. The installation consists of a heating device 1 and a glass flask 2. A glass flask with different concentrations of tomato paste (paste) is installed on the heating device. The product of various concentrations begins to boil, and this happens when the temperature at all points reaches the same temperature.

When intensive vaporization occurs when the product is heated not only from the surface, but throughout the entire volume, then boiling begins. The boiling point was measured with a multimeter (AM-520-EUR). To obtain various concentrations of tomato mass, tomato paste was dissolved with distilled water and the concentration was determined using a material balance.

The experimental setup works as follows: the flask is filled with a tomato mass of a certain concentration and heated to the boiling point.

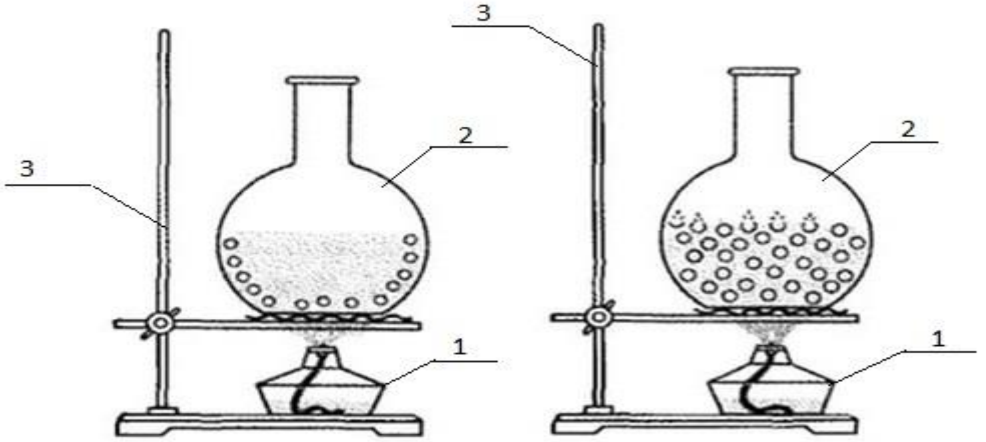

Fig. 1. Diagram of an experimental setup for determining the boiling point
1- Heating device; 2- Glass flask; 3- Tripod

Vaporization is divided into 2 types: evaporation and boiling. Boiling is intense vaporization that occurs when a liquid is heated not only from the surface, but throughout the entire volume.

In solutions with a lower concentration, air (gas) molecules are dissolved. When heated, this dissolved gas is released in the form of air bubbles at the bottom and walls of the vessel.

As the temperature of the liquid rises, water evaporates inside these bubbles, and they increase in size. Having reached a certain size, the bubbles detach from the surface.

If the water is not heated enough, then the vapor bubbles in the cold layers collapse. And if the temperature is sufficient, then they reach the surface of air or liquid and burst, releasing steam. At a certain temperature, tomato mass of various concentrations boils.

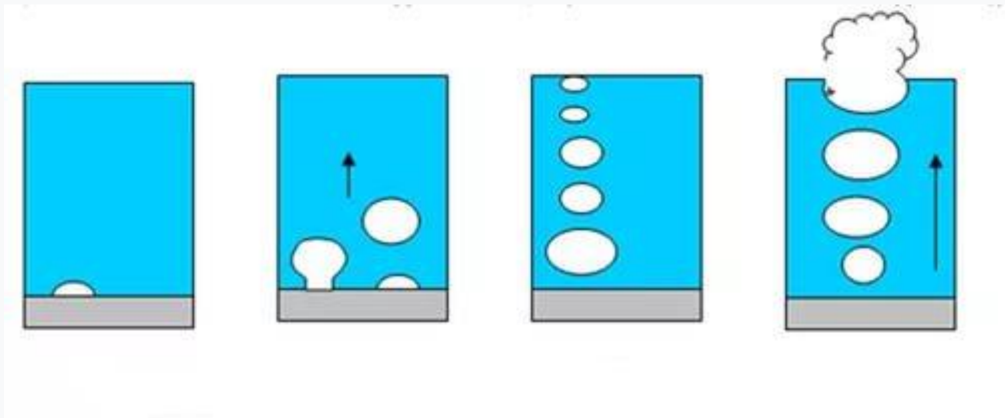

Figure: 2 Diagram of the stages of liquid boiling

3. Technique for conducting experiments

Experiments to determine the boiling point of tomato mass at atmospheric pressure were carried out in an installation, the diagram of which is shown in Fig. 1. The boiling point of the tomato mass was determined at various concentrations.

The experiments were carried out in the following sequence: the appropriate concentration of tomato mass 1/2 of the height is poured into the flask. Then, using a heating device, it is heated to the boiling point. When uniform boiling of the tomato mass is reached, the boiling point is measured with a multimeter (AM-520-EUR).

Maintaining the level of tomato mass in the vessel, the experiment was carried out for 0.5-1 hours. The boiling point was measured with a multimeter, the pressure is measured by the formula. The experiments were repeated in the order described above for different concentrations of licorice root extract 5, 10, 15, 20, 25% DM. Each experiment was carried out in triplicate at a steady state.

4. Results of the experiment

The experiments were carried out at various concentrations of tomato paste in the range from 5-25% DM. Table 4 shows the experimental data obtained on the experimental setup. The experiments were carried out in a steady state in triplicate. Based on the experimental data, the dependence of the boiling point of tomato paste of various concentrations at atmospheric pressure was plotted (Fig. 2.15). Analysis of the curves shows that when the tomato paste is heated, its density decreases, but increases with an increase in the concentration of dry substances. The higher the concentration of tomato paste, the higher the boiling point at atmospheric pressure.

To obtain an empirical equation of the form, the experiment was planned with a concentration range from 5% to 25% DM at atmospheric pressure.

$$t_k = f(\mathrm{DM}, P)$$

where: tk is the boiling point of the tomato paste, ° C;

DM - concentration of tomato paste,%;

P is atmospheric pressure, Pa;

Based on the processing of experimental data by the least squares method, an equation of the form was obtained:

$$T_k = b_0 + b_1 \cdot CB + b_2 \cdot P + b_4 \cdot CB \cdot P$$

The compiled program provides the possibility of calculating the correlation coefficient S. The resulting regression equation for determining the boiling point of tomato mass is:

$$T_k = \frac{31{,}027 + 1{,}76 \cdot P - 0{,}014 \cdot P^2}{69{,}45 \cdot \left(0{,}015 - 21{,}62 \cdot 10^{-6} \cdot CB - 9{,}2 \cdot 10^{-8} \cdot CB^2\right)}$$

Equation / 5 / can be used in thermal calculations of the evaporation process.

Table 1

Experimental values of the boiling point of various concentrations of tomato mass at atmospheric pressure

Atmosphere pressure mmHg.	DM concentration,%		
	5	10	15
760	98,10	98,80	99,50
760	98,00	98,00	98,10
760	93,00	93,50	93,80

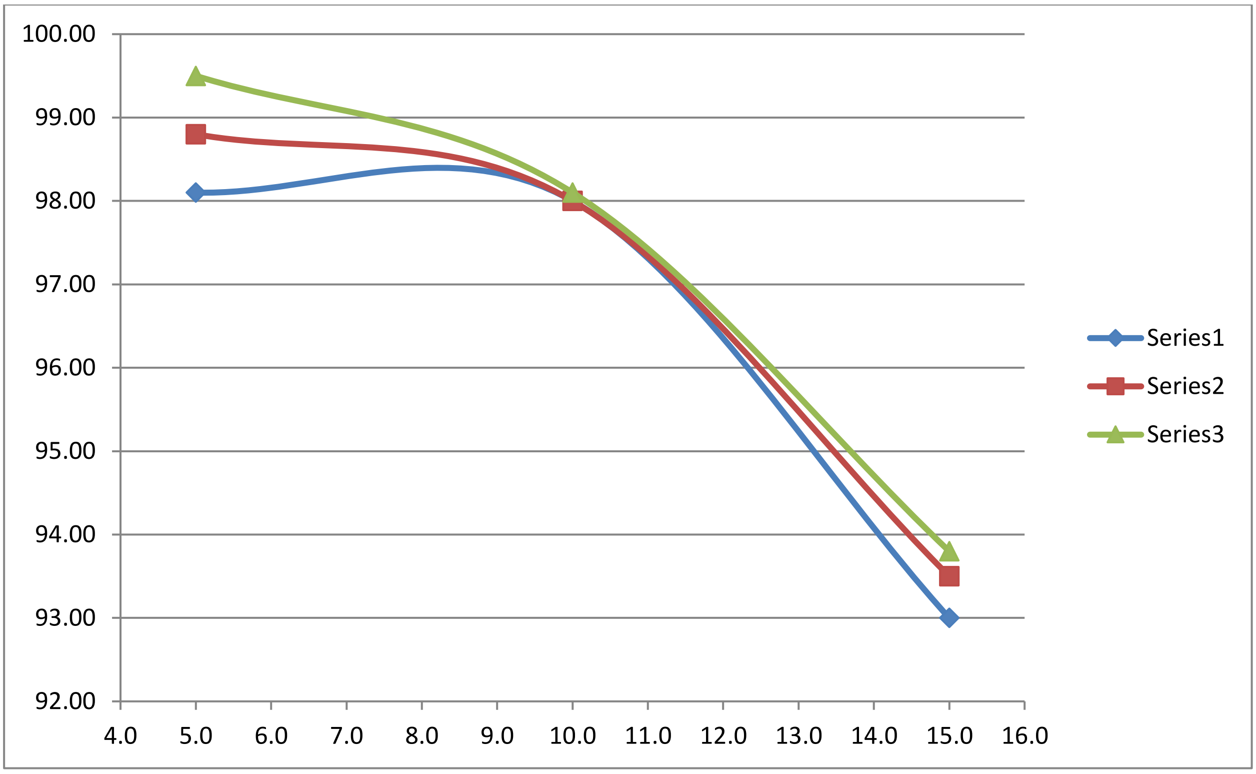

Fig. 2. Boiling points of various concentrations of tomato mass at atmospheric pressure

List of used literatures

1. Musaeva R.X., Uvayzov S.K., Musaeva N.X., Qo'ldosheva F.S., Akramov D.R. Research and experimental determination of thermo physical propertiesof highly foaming solution // Volume 24, Issue 6, March 2020, London, UK. pp. 4611-4620.

2. Modeling the process of evaporation of concentrated grape juice. Materials of the international scientific conference "Innovative solutions to engineering and technological problems of modern production". 1-volume. BEATY. Bukhara, November 14-16, 2019, p. 372-374.

3. Artikov A.A. Computer methods of analysis and synthesis of chemical-technological systems // Textbook for masters of theological specialties. Tashkent: Voris nashriyot. 2012.135 p.

4. A. Artikov. Tizimli taҳlil, mathematician modelashtirish va hechim topish asoslari // Toshkent. 2015.316 b.

5. R.X. Musayeva, N.X. Musayeva, U.K. Tursunov. Research of mathematical model of statistics of the steaming process of tomato paste // India. IJARSET Journal. 2019. # 6.126. 11062-11065 p.

6.R.Kh. Musaeva, O. K. Solieva, F.S. Kuldasheva, N.Kh. Musaeva. Investigation of the mathematical model of the statics of the process of evaporation of licorice root extract // Universum: Chemistry and biology. Science Magazine. Moscow. 2019 # 6. 20-22 s.

7. Siddikov I. Kh., Ismoilov Kh. B. Development of a mathematical model of the process of evaporation of cotton oil // Electronic innovative bulletin. - 2020. - No. 4. - S. 9-13.

8.https://www.yaklass.ru/p/fizika/8-klass/izmenenie-sostoianiia-veshchestva-141552/kipenie-temperatura-kipeniia-udelnaia-teplota-paroobrazovaniia-141553/re-4d3bdba3-9611-451e-b1eb-9e102c82d4e6

9.F.Yu.Khabibov, M.S.Narziyev, M.A.Abdullayeva. Optimization Of The Final Distillation Process By Multi-Stage Atomization Of Vegetable Oil Miscella. The American Journal of Applied Sciences, (ISSN – 2689-0992) Published: September 30, 2020, Pages: 255-262: 5. 276, The USA Journals.

10. Abidov K.Z., Ergashev B.T. Hydrodynamic parameters of a pulsating flow of mixtures in a flat pierced pipe, taking into account the force of gravity. Collection of scientific papers of the XIV-th International scientific-

practical conference "Modern instrumental systems, information technologies and innovations." Southwestern State University. Russia. Kursk, March 13-14, 2019, p-6-12.