



III International Scientific Conference “Sustainable and efficient use
of energy, water and natural resources – SEWAN-2021”

ГАЛАХИМ



Study of the physical and chemical characteristics of biochar obtained by steam gasification of beer industry waste

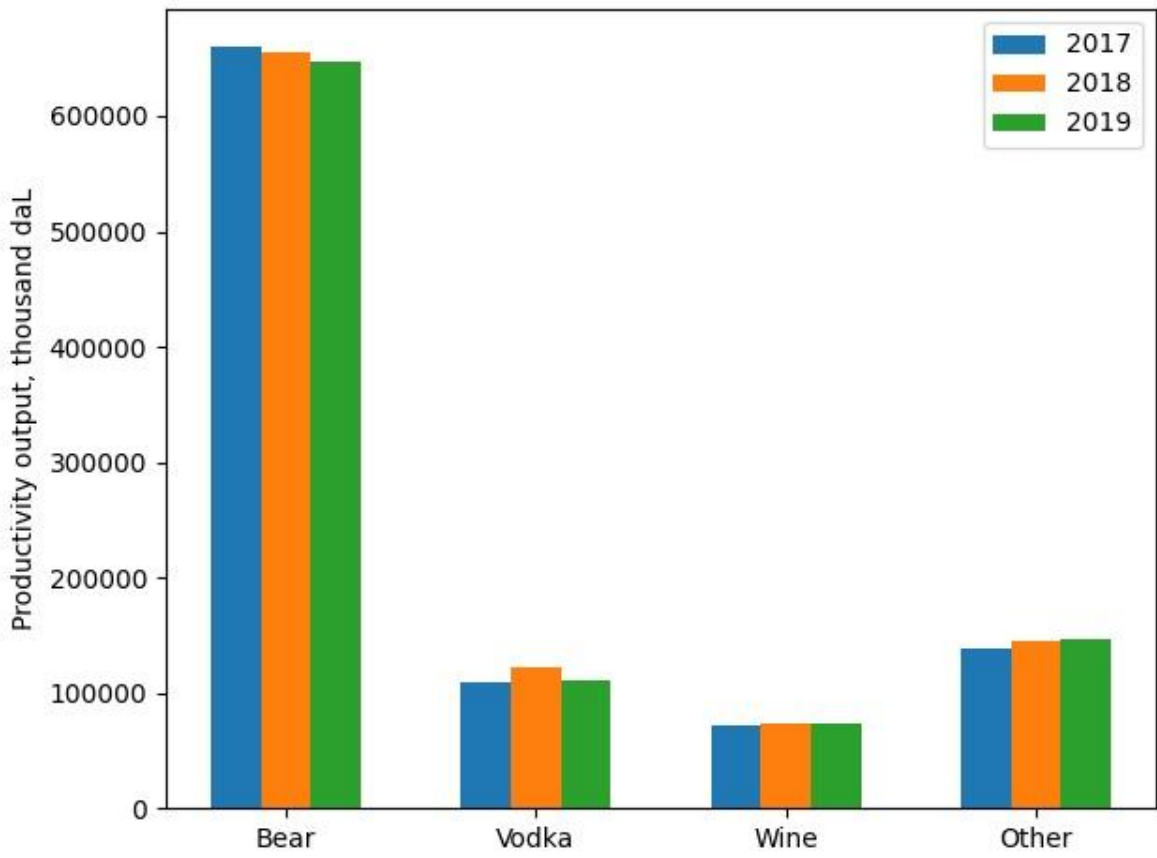
Authors: Larionov K., Zenkov A., Kaltaev A.

Affiliations: Tomsk Polytechnic University

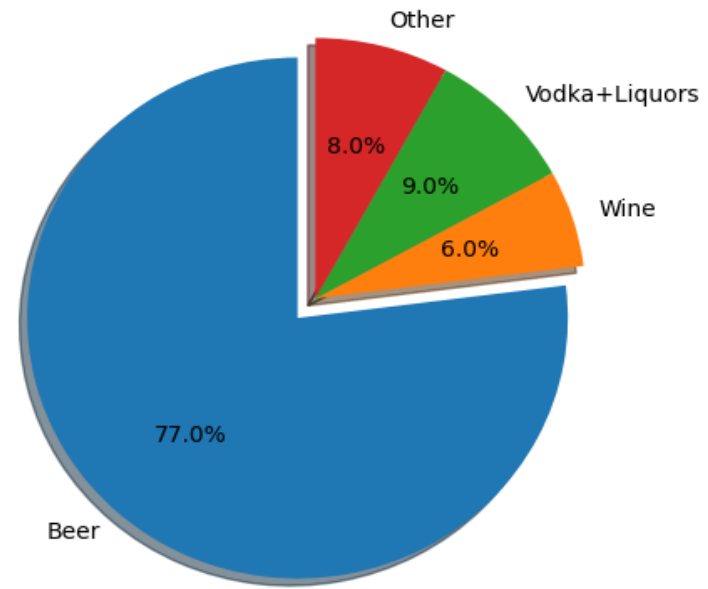
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Keywords:
Beer industry waste, steam gasification, CO, technical specification, elemental composition



Alcohol production by years¹



Foot print in the market¹

¹<https://fsrar.gov.ru/> - Rosalkogolregulirovanie

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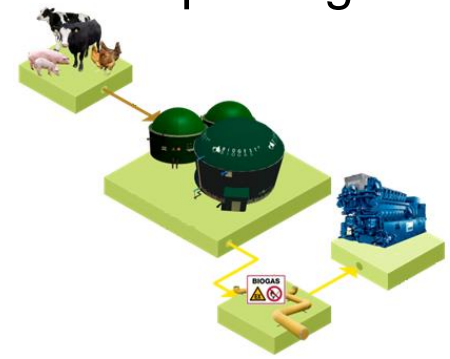
Beer waste



Cattle fodder



Composting



Energy application (burning and gasification)

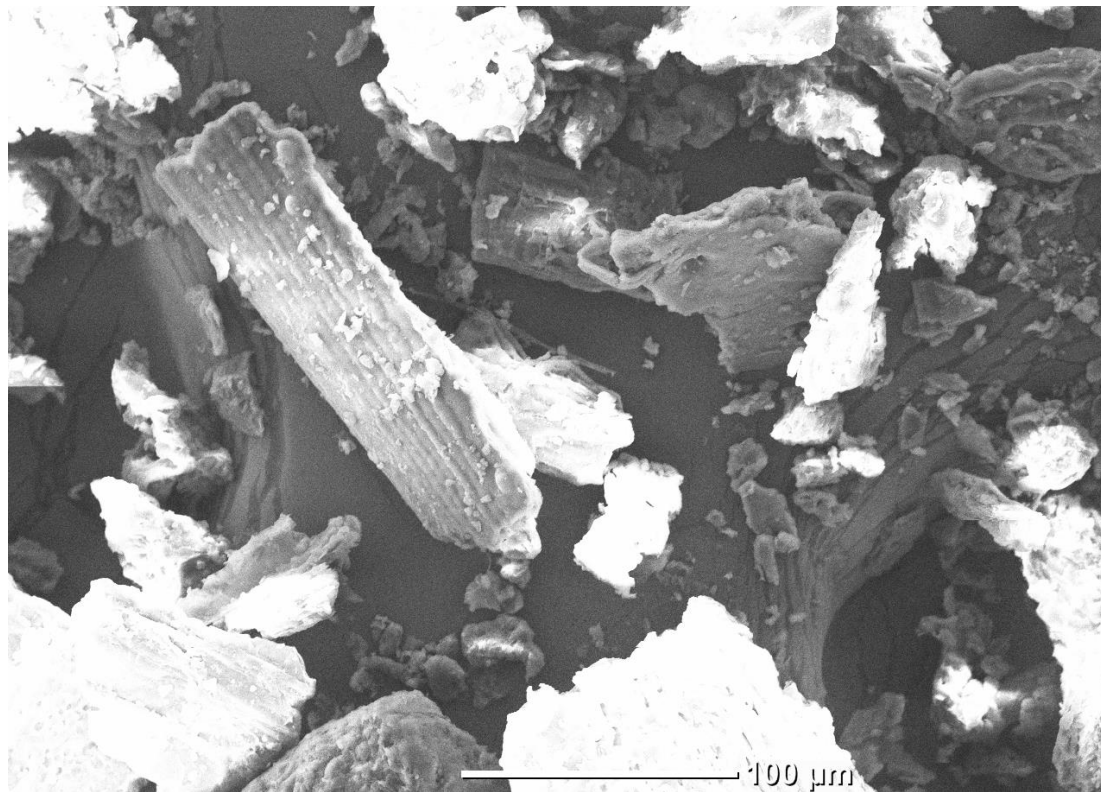


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Scanning electron microscopy initial sample of beer industry waste particles

Sample characteristics

Raw moisture, wt.%	80
Moisture after drying, wt.%	10
Particle size, cm	1-3



Initial sample

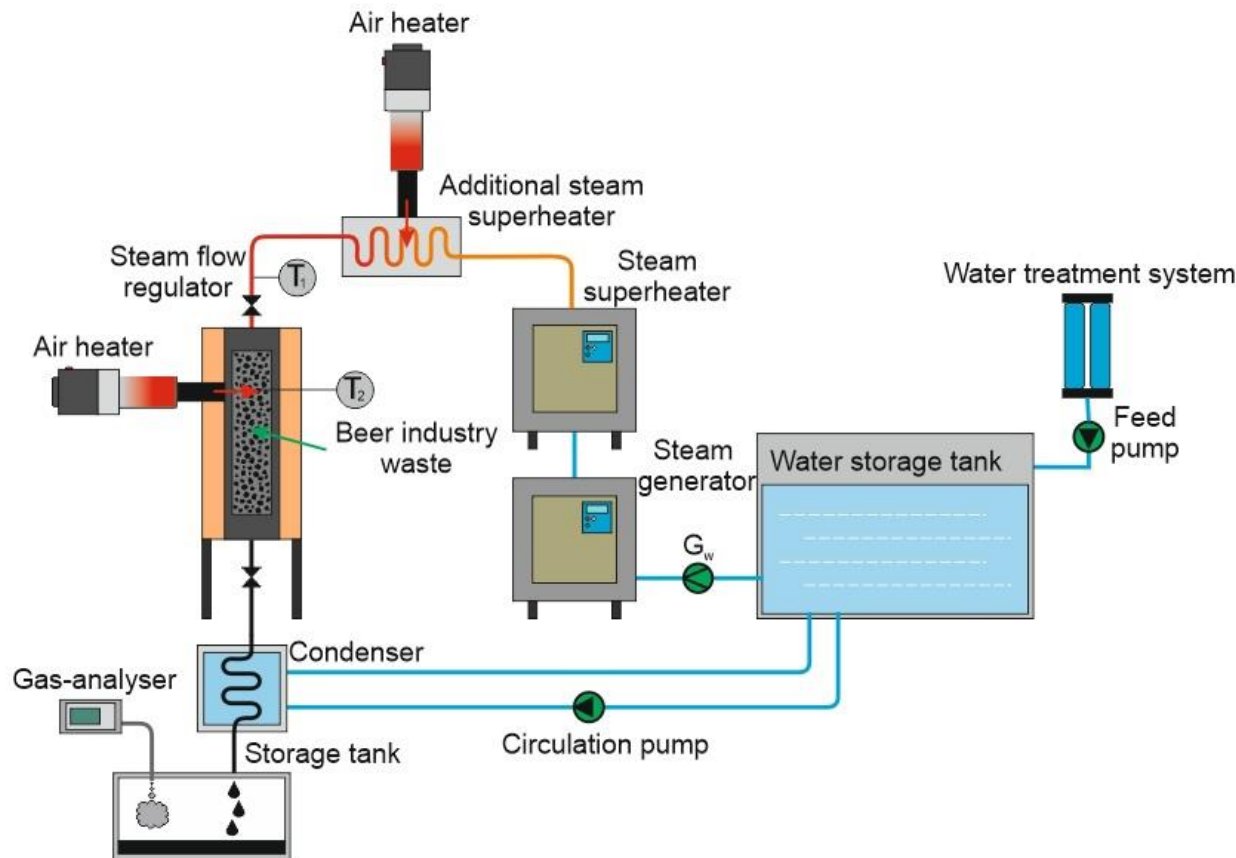
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Experiment parameters

Sample weight, kg	1
Steam temperature, °C	450
Steam flow rate, kg/h	5
Exposure time, h	1

Basic scheme of the experimental steam gasification unit

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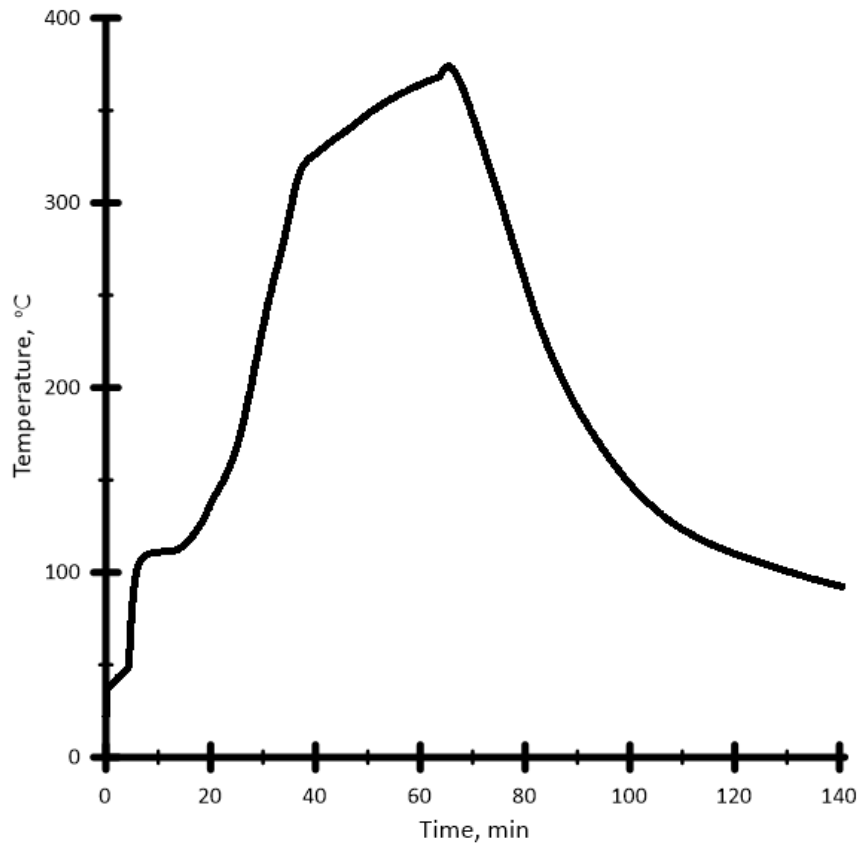
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Results



Maximum concentration values

CO, vol.%	CO ₂ , vol.%	CH ₄ , vol.%	H ₂ , vol.%
12.6	46.6	10	1.9

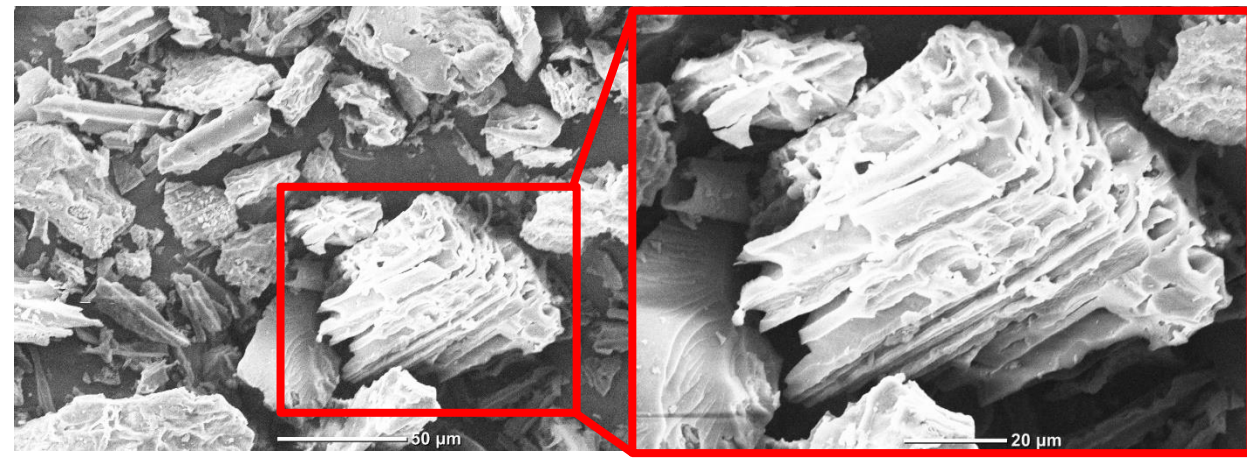
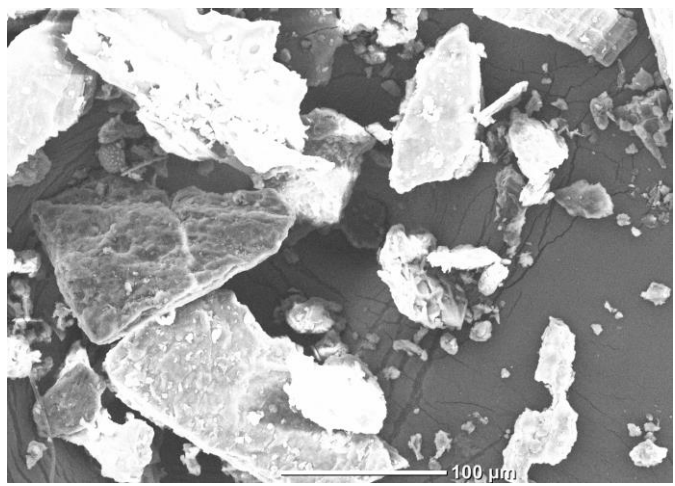
Change of temperature in the sample

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Scanning electron microscopy initial sample of beer industry waste particles

Scanning electron microscopy of carbon residue from beer industry waste particles

Specifications

Sample	W^r	A^d	V^{daf}	O_i^r	C^d	H^d	N^d	S^d	O^d
	wt. %			MJ/kg	wt. %				
Beer waste industry	6.6	7.2	66.5	19.6	51,40	6,10	5,70	0,60	36,1
Carbon residue	4.3	17.1	32.6	26.0	63,8	3,7	4,7	0,2	10,5

r-as received basis, daf-dry ash free, d-Dry Basis

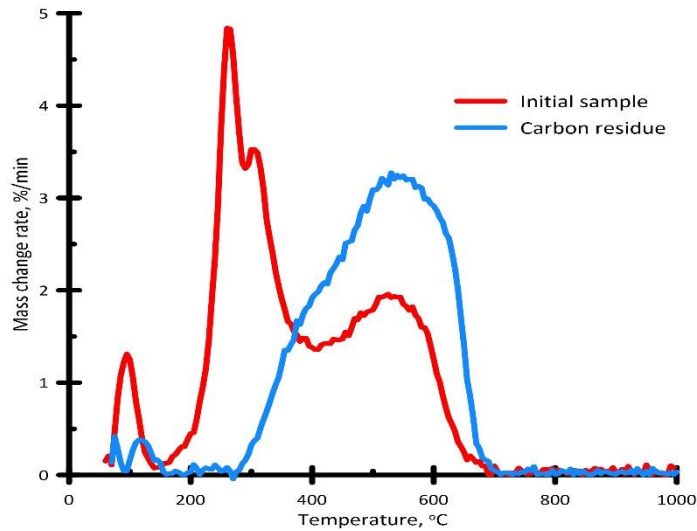
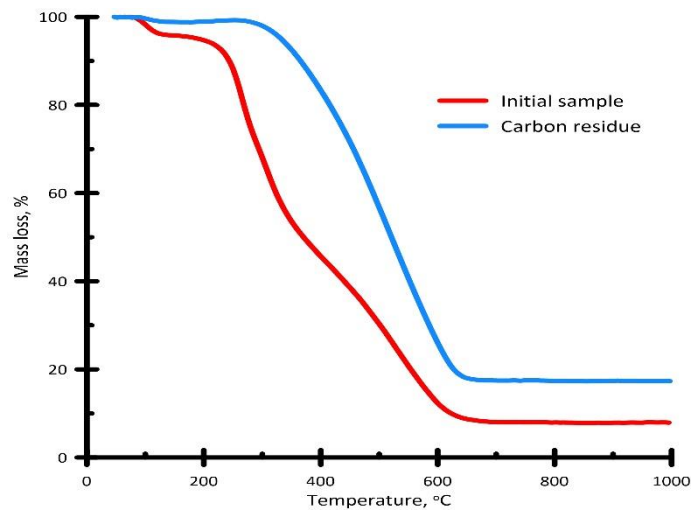
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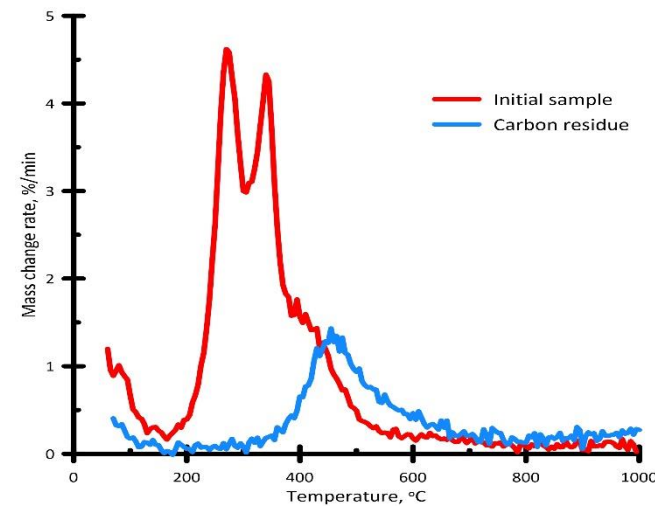
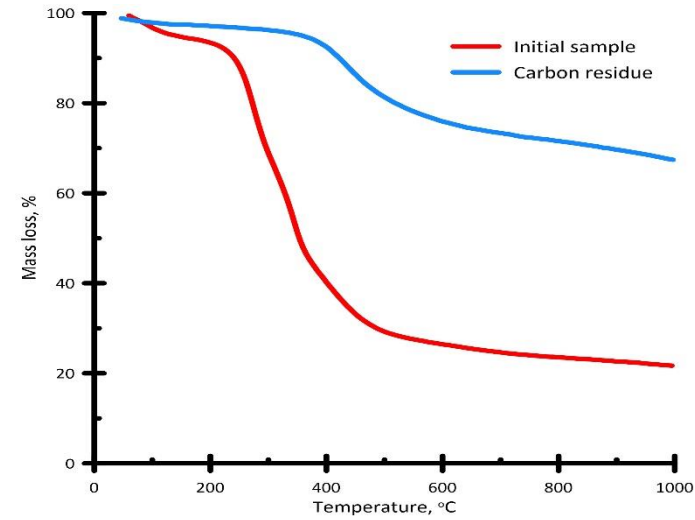
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TG, DTG profiles of the initial sample and carbon residue in oxidizing medium



TG, DTG profiles of the initial sample and carbon residue in an inert medium

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Conclusions

- It was found that the process of steam gasification of beer industry wastes is accompanied by high CO₂ emission, which is associated with a high content of oxygen in the material
- The produced carbon has a low calorific value (26 MJ/kg), comparable with fossil fuel.
- High ash content during chemical activation (e.g., HCl) can increase the specific surface area of carbon material particles

References

1. Beer, production [Electronic resource] // Fira. 2019. URL: <https://pro.fira.ru> (accessed: 22.02.2021).
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3. Russ W., Mörtel H., Meyer-Pittroff R. // Constr. Build. Mater. 2005. T. 19. № 2. P. 117–126..

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Thank you for your attention!

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