

Kazan Federal University
Institute of Ecology and Geography

Problems of municipal waste utilization in big cities (Kazan experience)

*«Проблемы утилизации городских отходов в больших городах
(на примере г. Казани)»*

The new challenges for urban development: global and local.

Kazan (Volga region) Federal University

Institute for Comparative Studies of Modernity

Centre for Advanced Economic Studies Academy of Sciences of Republic of
Tatarstan, School of Geography, University of Birmingham,

British council

International workshop

Polina Galitskaya,

S. Selivanovskaya, P. Zvereva, L. Biktasheva, A. Nizamutdinova

Kazan

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The amount of solid wastes in Republic of Tatarstan

| Year | Total amount of solid wastes, thousand of tones | Amount of agricultural solid wastes, thousand of tones | Amount of municipal wastes, thousand of tones | Amount of industrial solid wastes, thousand of tones |
|-------------|---|--|---|--|
| 2002 | 12148,408 | 9965,687 | 801,44 | 1381,281 |
| 2003 | 12483,821 | 9924,768 | 816,54 | 1742,513 |
| 2004 | 11949,797 | 9488,217 | 739,32 | 1722,26 |
| 2005 | 12042,292 | 9191,429 | 777,519 | 2073,344 |
| 2006 | 14230,064 | 10178,565 | 1077,486 | 2974,013 |
| 2007 | 9410,492 | 4511,25 | 1194,808 | 3704,434 |
| 2008 | 10789,064 | 6030,134 | 1242,133 | 3516,797 |
| 2009 | 9901,283 | 6171,766 | 1148,100 | 2581,417 |
| 2010 | 10311,220 | 6283,450 | 1265,370 | 2762,400 |

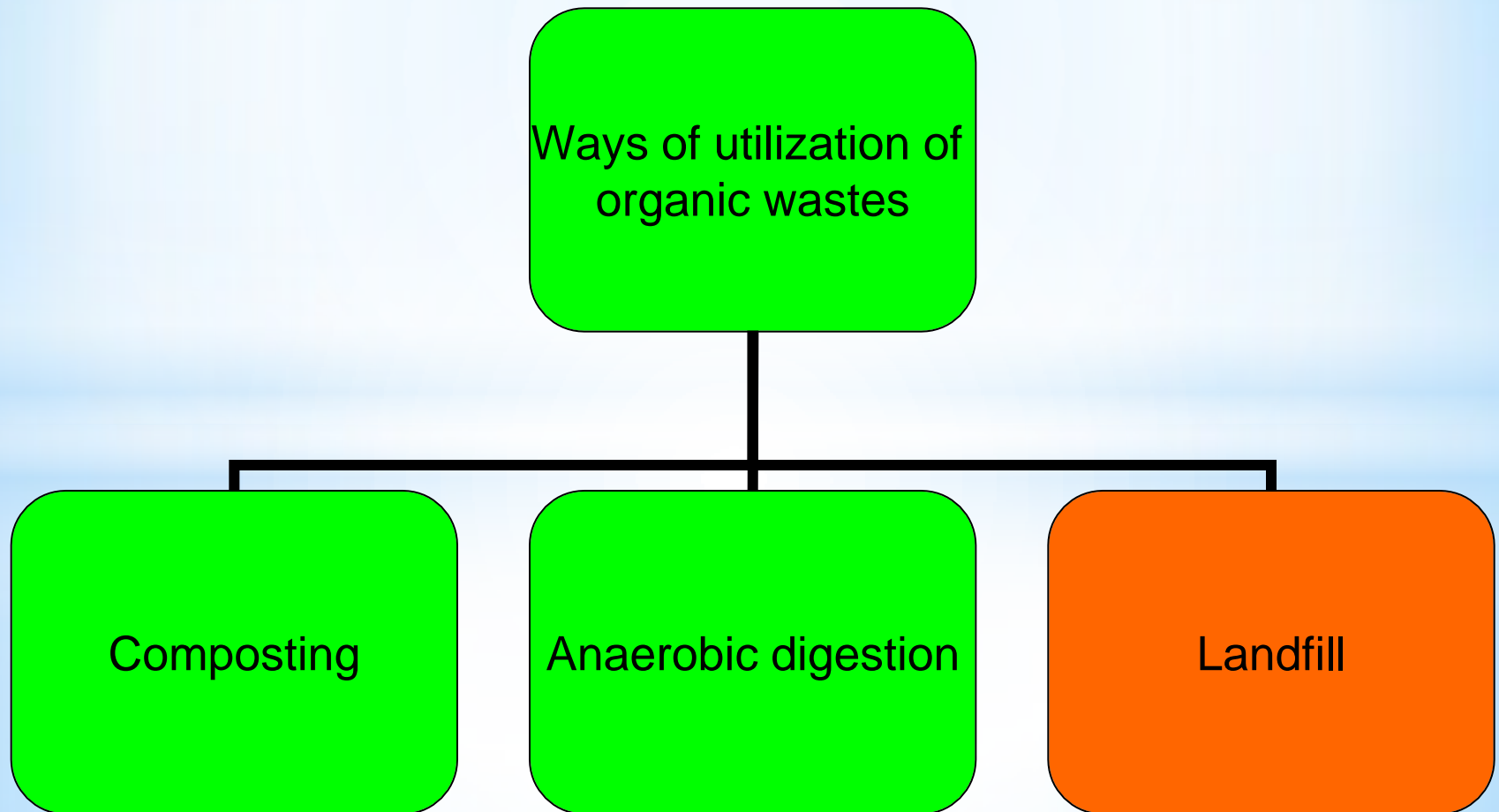
Biodegradation of
organic wastes

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graph TD; A[Biodegradation of organic wastes] --> B[Composting]; A --> C[Anaerobic digestion];
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Composting

Anaerobic digestion

What happens with Russian organic waste



Wastes have different characteristics:

- Organic matter content;
- Particle size;
- Moisture;
- pH;
- Concentration of toxic compounds;
- Concentration of hard-degradable compounds;
- etc.



Preparation of mixtures from wastes with different characteristics can lead to increase of effectiveness of their anaerobic digestion.

Characteristics of 8 organic wastes

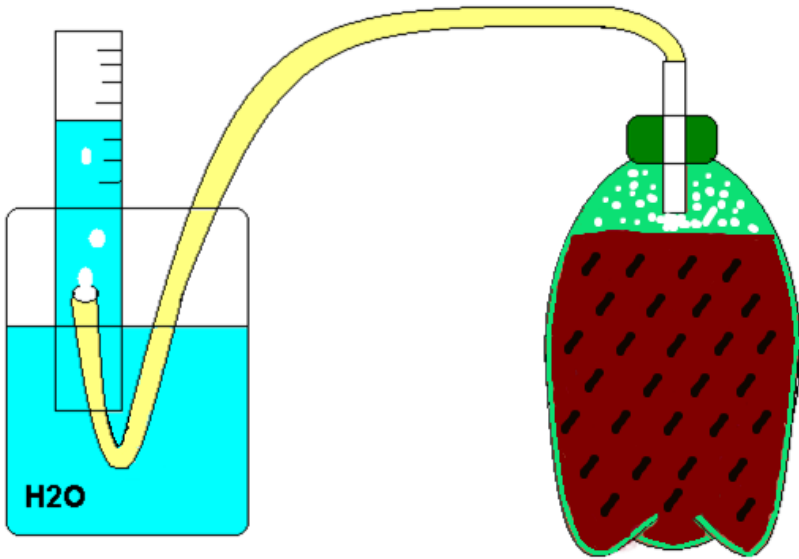
| Types of wastes | Corg, mg/g DM | Ntot, % (DM) | pH | Moisture, % |
|--|------------------|--------------|-----|-------------|
| Sewage sludge (SS) | 26,92 | 3,01 | 7,9 | 96,18 |
| Unsorted organic fraction of municipal solid waste (MSW) | 13,65 | 1,63 | 6,4 | 70,88 |
| Chicken guano (G) | 10,8 | 4,96 | 6,4 | 75,25 |
| Used fats (F) | 57,91 | 0,51 | 5,7 | 1,34 |
| Food waste (Food) | 45,27 | 2,09 | 4,6 | 61,04 |
| Drainaged SS (DSS) | 36,63 | 3,12 | 6,7 | 60,02 |
| Sawdust contaminated by oil-products (SD) | 80,72 | 0,21 | 5,2 | 3,74 |
| Overdue tinned vegetables (V) | 31,06 | 1,45 | 4,5 | 76,9 |

Toxicity of 8 wastes to *Paramecium caudatum* and *Raphanus sativus*

| Types of wastes | ТОКСИЧНОСТЬ ОТХОДОВ | | | |
|-----------------|---------------------|-----------------|-------------------|-----------------|
| | <i>P. caudatum</i> | | <i>R. sativus</i> | |
| | DF 10 | Hazardous class | DF 10 | Hazardous class |
| SS | 1 | V | 1 | V |
| MSW | >10 | IV | 112 | III |
| G | 13 | IV | 9 | IV |
| F | >10 | IV | 6 | IV |
| Food | 1 | V | 1 | V |
| DSS | 4 | IV | 85 | IV |
| SD | 3 | IV | 124 | III |
| V | 1 | V | 1 | V |

Characteristics of wastes' mixtures

| Mixtures | Corg mg/g | Ntot, % DMDM | pH | Moisture % | Toxicity | | | |
|----------|--------------|-----------------|-----|---------------|--------------------|-----------------|-------------------|-----------------|
| | | | | | <i>P. caudatum</i> | | <i>R. sativus</i> | |
| | | | | | DF 10 | Hazardous class | DF 10 | Hazardous class |
| SS+SD | 33,35 | 1,3 | 7,8 | 90,75 | 15 | IV | 5 | IV |
| SS+F | 30,75 | 0,3 | 7,8 | 18,5 | 12 | IV | 5 | IV |
| SS+V | 30,75 | 2,8 | 6,9 | 96,59 | 10 | IV | 4 | IV |
| SS+Food | 31,99 | 2,8 | 7,5 | 79,94 | 10 | IV | 5 | IV |
| G+SD | 59,98 | 3,8 | 8,9 | 54,52 | 18 | IV | 7 | IV |
| G+Food | 31,12 | 4,6 | 7,4 | 64,22 | 15 | IV | 1 | V |
| G+V | 29,9 | 1,3 | 8,5 | 84,79 | 8 | IV | 3 | IV |
| G+F | 20,3 | 3,9 | 7,5 | 3,33 | 9 | IV | 1 | V |
| G+MSW | 13,7 | 0,6 | 8 | 72,11 | 6 | IV | 1 | V |
| MSW+DSS | 35,3 | 2,4 | 6,3 | 93,97 | 3 | IV | 1 | V |
| MSW+F | 28,8 | 2,1 | 6,1 | 95,91 | 11 | IV | 94 | IV |
| MSW+V | 31 | 2,3 | 6,2 | 90 | 15 | IV | 84 | IV |
| MSW+SS | 22,3 | 2,9 | 6,9 | 98,41 | 1 | V | 75 | IV |



Bioreactors for digestion

Screening
Cumulative volume of biogas (14 days)

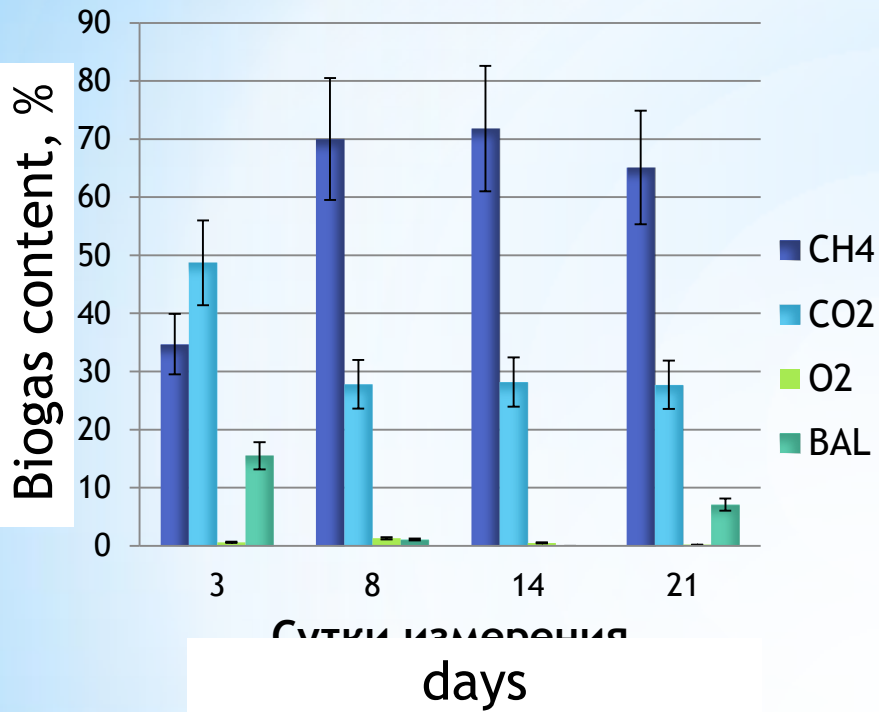
| Types of wastes | | Biogas volume (ml/g DM) | | | | | | | |
|-----------------|------|-------------------------|-------|------|-----|------|------|------|------|
| | | SS | MSW | G | F | Food | DSS | SD | V |
| Basic | SS | 34,2 | | | | | | | |
| | MSW | 60,66 | 32,17 | | | | | | |
| Additional | G | | 18,97 | 9,12 | | | | | |
| | F | 1,57 | 14,36 | 1,26 | 0,6 | | | | |
| | Food | 6,07 | | 1,08 | | 2,24 | | | |
| | DSS | | 19,88 | | | | 4,29 | | |
| | SD | 13,26 | | 1,42 | | | | 1,13 | |
| | V | 12,42 | 16,83 | 5,08 | | | | | 2,41 |



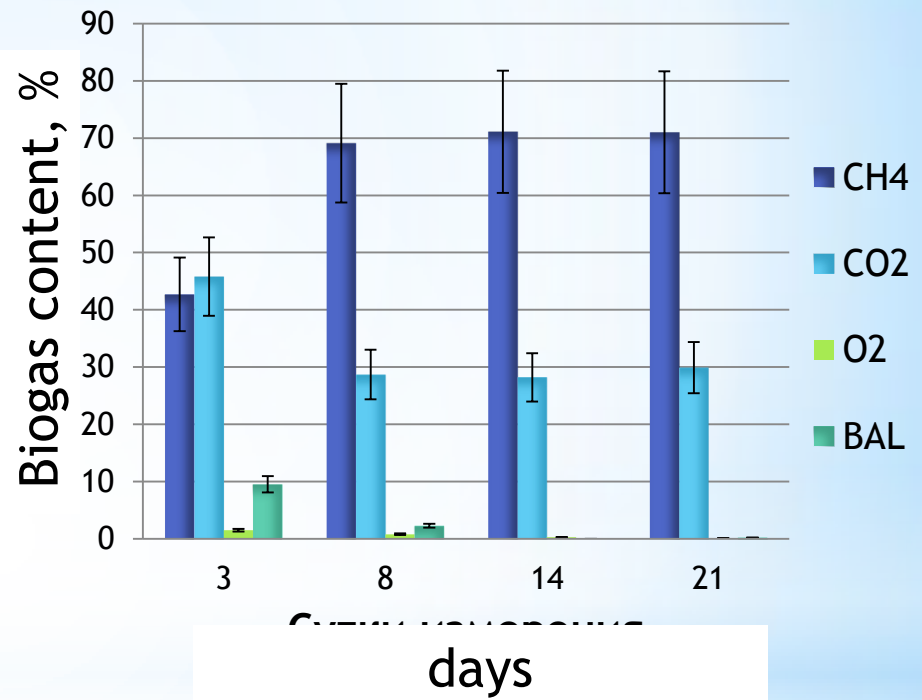
Bioreactors with constant mixing



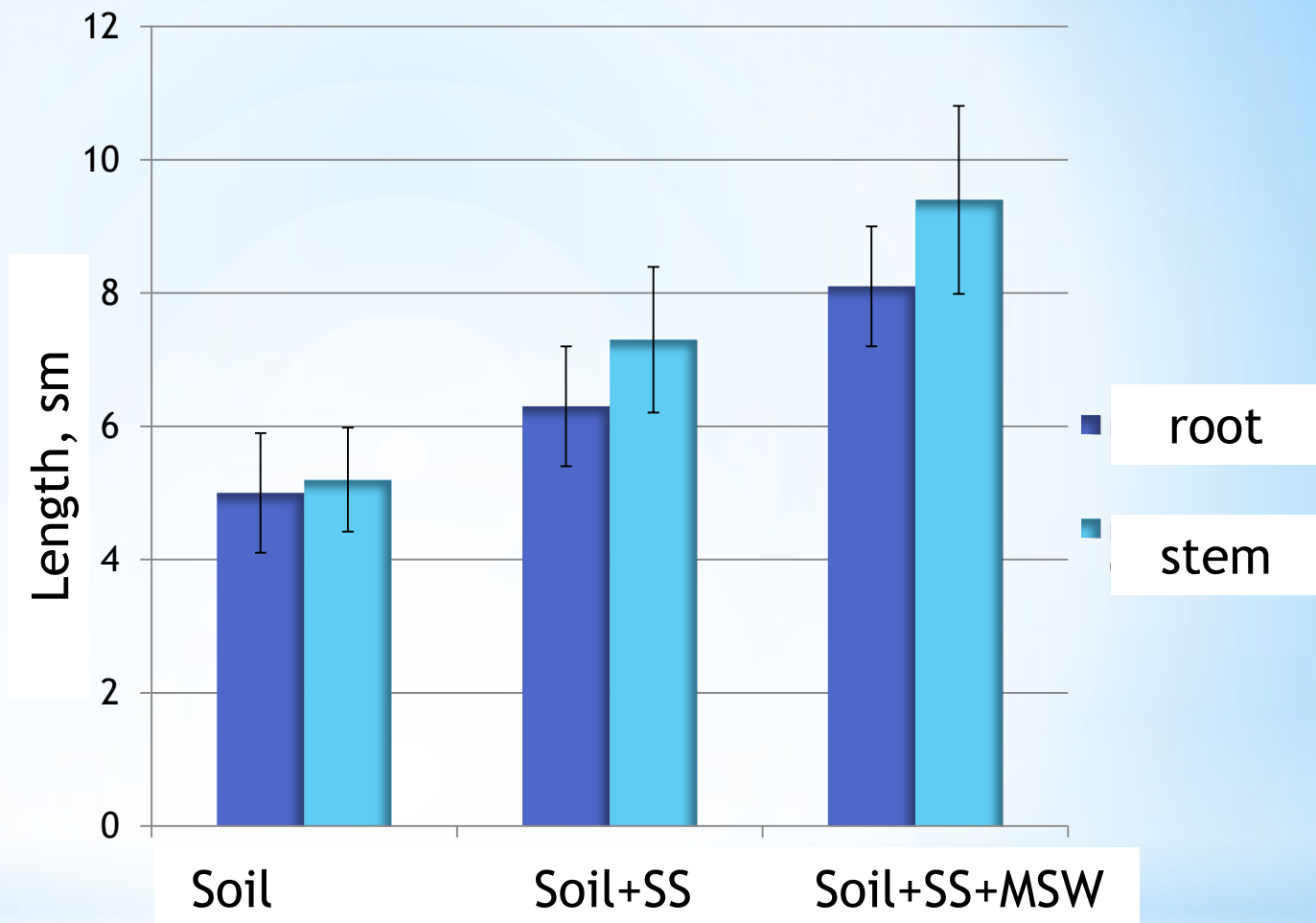
a



b



Concentration of components of biogas:
 a. SS
 b. SS+MSW



Influence of digestion rests on plants

Thank you for attention

