BIOMASS (2)

DIDACTIC MATERIALS

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2. TYPES OF BIOMASS MAIN PROPERTIES

Biomass is organic materials of plant, fungal or animal origin, which by burning can be a source of energy, by digesting anaerobically or transforming chemically.

From the energy's point of view, the most valuable element in biomass is carbon.

By burning biomass or its products, CO_2 is released from them, but this coal is taken from the nature and can be receded by growing new plants.

By burning biomass (wood), during growth releases accumulated solar energy.

Solar energy's conversion to the biomass takes place during the process of photosynthesis.

Wood biomass production to the conditions of 4 factors:

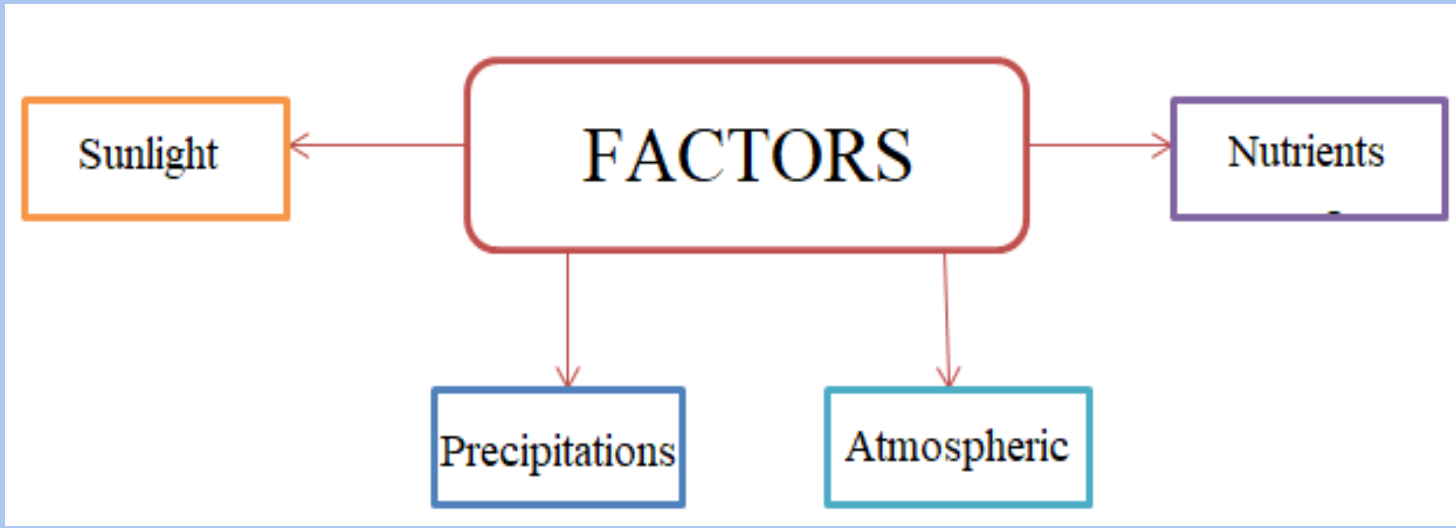

Fig. 4. The biomass production factors

Bioenergy – the energy released into power plants is converted into heat and electricity.

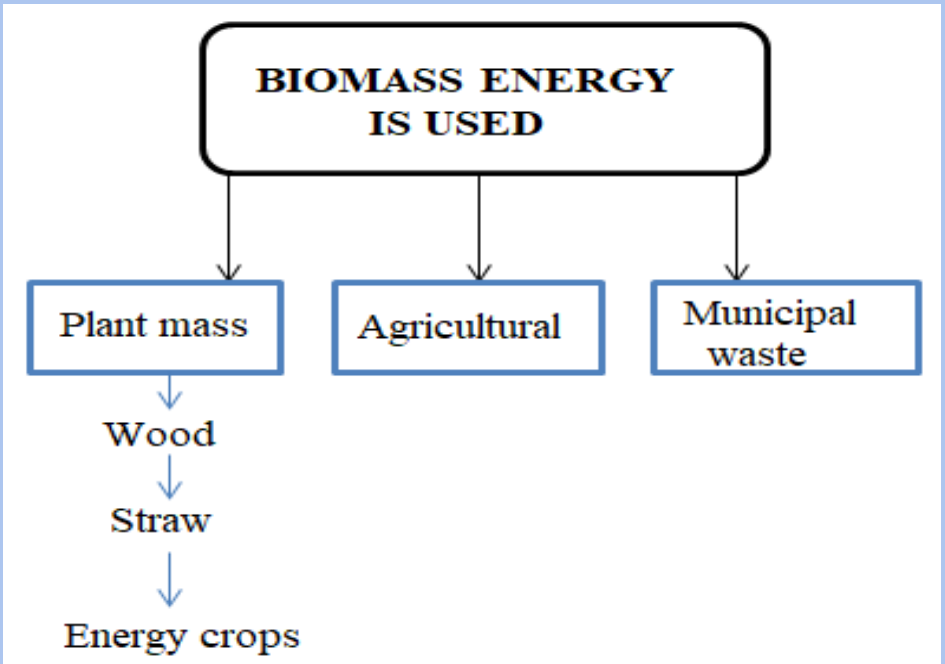

Fig. 5. Raw materials for biomass for energy

Biomass is divided into dry biomass:

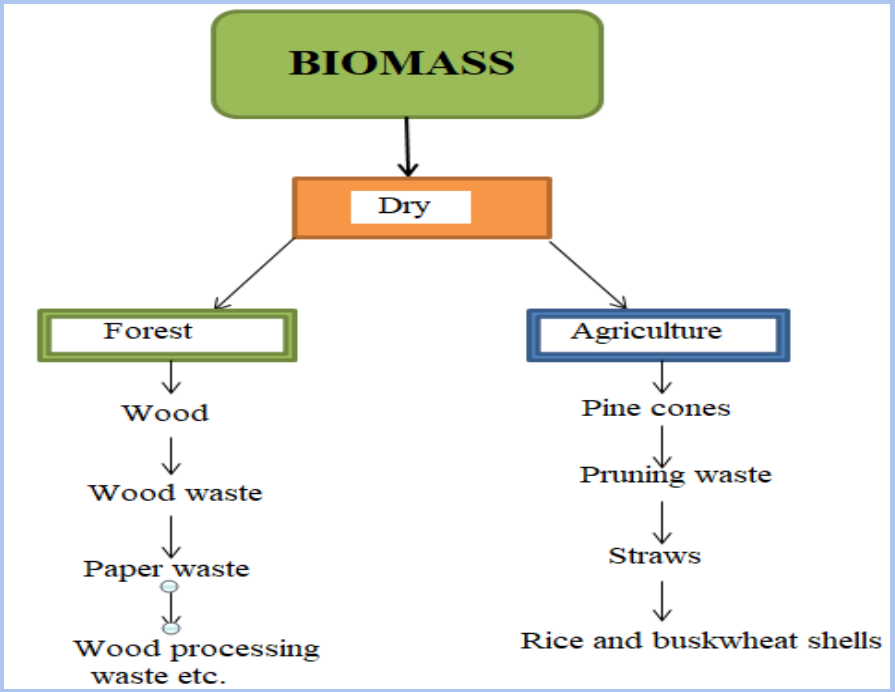

Fig.6. The dry biomass feedstock

Biomass is divided into *wet* biomass:

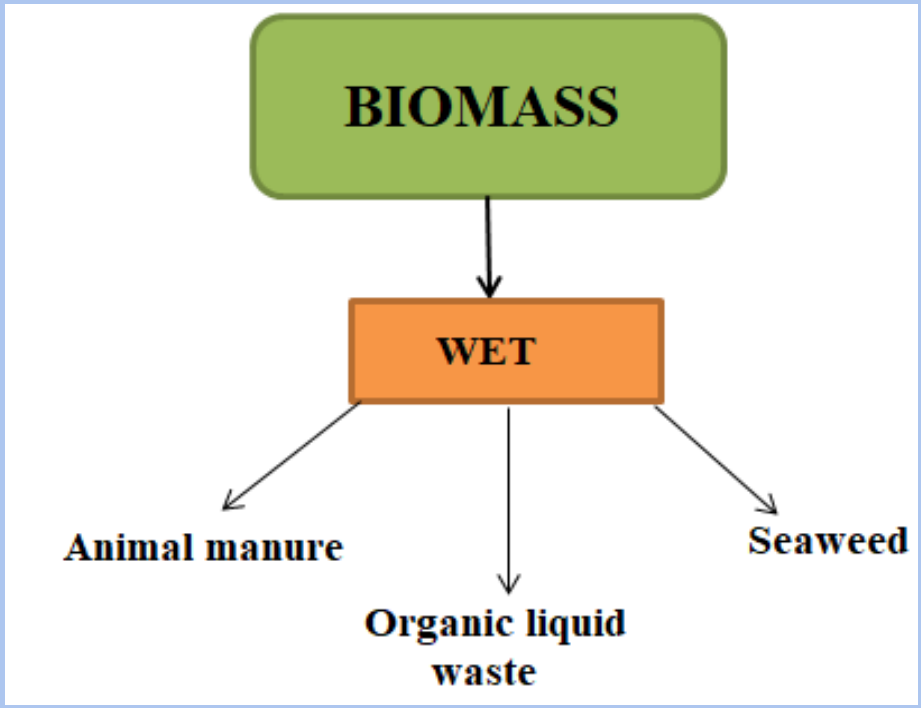

Fig. 7. Wet biomass feedstock

According to *the origin* of biomass is divided into *plant and animal*.

The *plant* biomass comprising:

1. Fat and oils.
2. Cellulose, starch, sugar.
3. Protein.
4. Lignin.

The biomass is *composed* of:

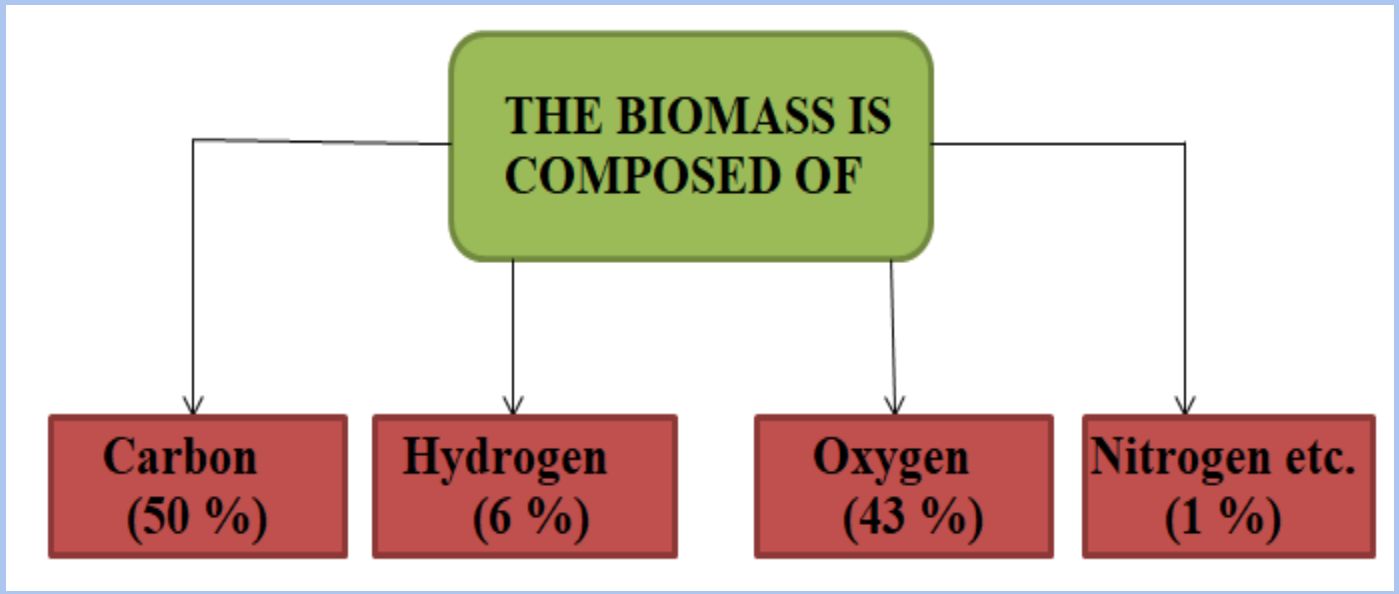

Fig. 8. Basic chemical elements of biomass

The most important fuel properties are these:

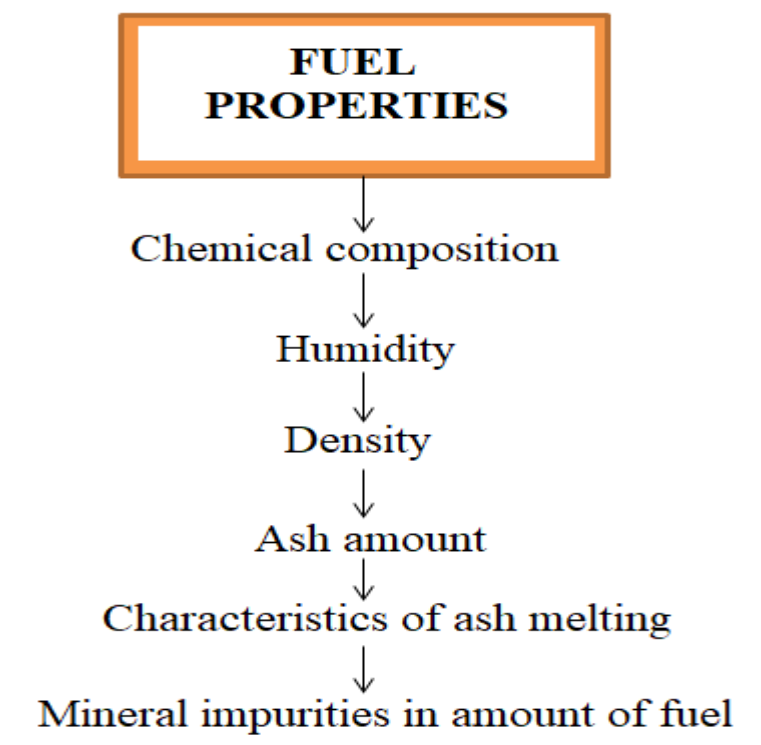

Fig. 9. The main characteristics of biofuels

TYPES OF WOOD FUELS

According to the origin of *the raw material* wood fuel is divided into:

1. Fuel from the forest;
2. Quickly rising (energy) forests;
3. Re-usable wood.

Wood fuel classification of the origin of raw materials shown in Figure 10:

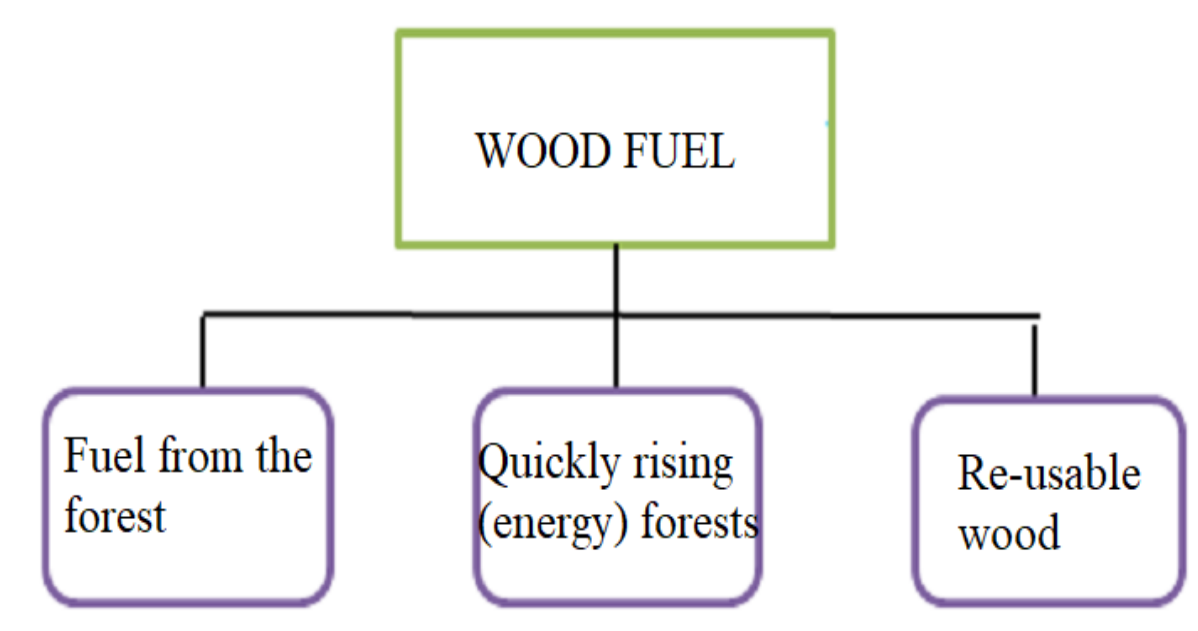

Fig. 10. Wood fuel classification of the origin of raw materials

Rapid growth forests (willows – energetic crops):

Fig.11. Energy forests
http://www.biokuras.lt/en

Wood fuel classification according to the degree of processing presented in Figure 12:

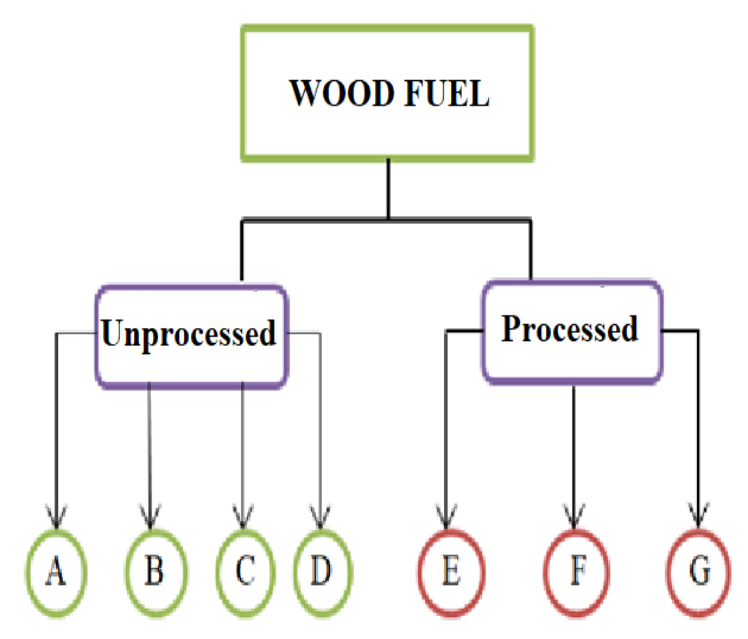

Fig. 12. Wood fuel classification according to the degree of processing presented

A – Tradicional firewood;

B – Compressed forest waste;

C – Wood chips;

D – Sawdusts;

E – Briquettes;

F – Pellets;

G – Wood dust.

Wood fuels, other biofuels and peats are composed of *combustible and non-combustible* part.

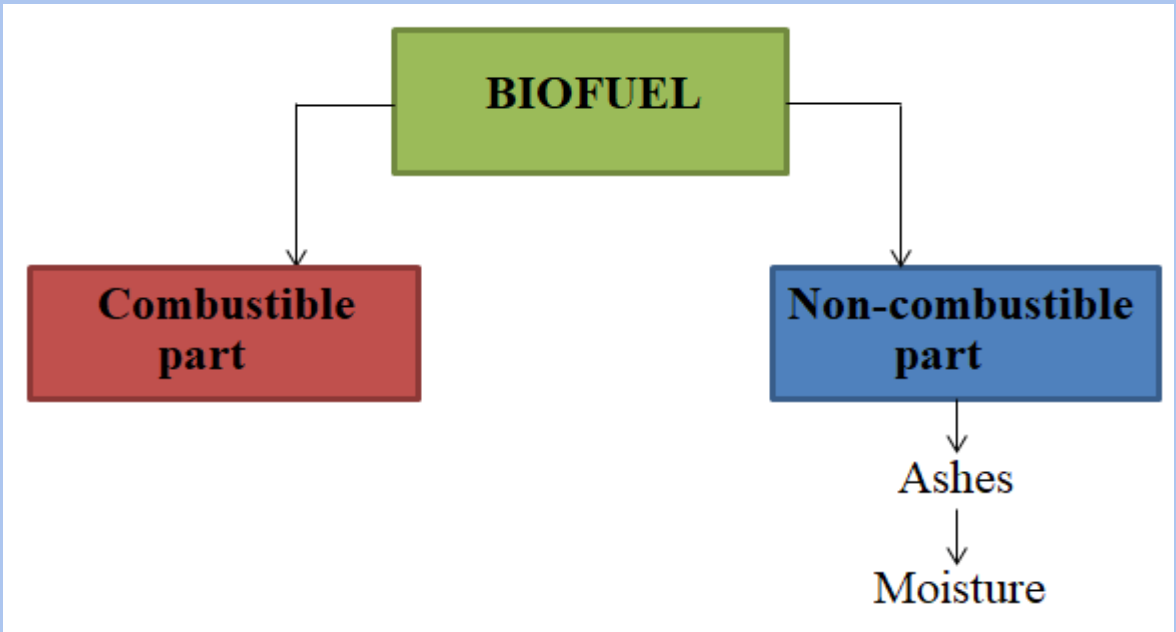

Fig.13. Biofuel combustible and non-combustible parts

In wood fuel‘s elemental composition these following components: carbon (C), hydrogen (H) and oxygen (O), together which make up about 99 % of dry mass; nitrogen (N) content doesn‘t exceed 0,2%, and sulfur (S) - 0.05% of dry mass.

In perspective, the amount of sulfur in fuel is the most important for emissions.

Calorific capacity (calorification of fuel).

Fuel combustion heat is the amount of heat, released from completely burnt 1 kg of solid fuel. Heating value measured in MJ / kg or kJ / kg.

Fuel combustion heat (calorific value) is distributed into *higher* and *lower* calorific capacity.

Higher calorific value is calculated by assessing release of water vapors in the combustion products due to condensation of fuel moisture and hydrogen (as a combustion product).

In calculation of *lower* calorific value, the condensation of water vapor and heat in combustion products are ignored.

Wood calorific value of wood species presented in Table:

Table 1

Variety of a Tree	Stem without bark	Bark	Whole stem	Branches and tops	Whole tree
Scots pine	19,31	19,53	19,33	20,23	19,52
Scots Fir	19,05	18,80	19,02	19,17	19,29
Shaggy Birch	18,68	22,75	19,19	19,94	19,30
Birch	18,61	22,52	19,15	19,53	19,29
White Alder	18,67	21,57	19,00	20,03	19,18
Black Alder	18,89	21,48	19,31	19,37	19,31
Asp	18,67	18,57	18,65	18,61	18,65

Lower calorific value of most common tree species, MJ/kg[R.2]

Main energy features of solid biofuels:

- Calorific capacity (calorific value);
- Humidity;
- Ash content.

Calorific capacity of used fuel mass mainly depends upon *the origin of biofuel, amount of moisture, present in used fuel mass, in used fuel ash*.

In biofuel, some varieties of trees lower calorific capacity depends from the amount of moisture in used fuel mass [R.2]:

Table 2

Moisture of the fuel (W)	Lower calorific capacity of fuel MJ/kg							
	Pine	Fir	Birch	Asp	Black Alder	White Alder	Maple	Linden
20	15,13	14,94	14,95	14,43	14,96	14,86	14,95	14,95
25	14,03	13,86	13,86	13,38	13,87	13,77	13,86	13,86
30	12,93	12,77	12,78	12,32	12,78	12,69	12,78	12,78
35	11,83	11,68	11,69	11,27	11,70	11,61	11,69	11,69
40	10,73	10,60	10,60	10,21	10,61	10,53	10,60	10,60
45	9,64	9,51	9,52	9,16	9,52	9,45	9,52	9,52
50	8,54	8,42	8,43	8,10	8,43	8,37	8,43	8,43
55	7,44	7,34	7,34	7,05	7,35	7,29	7,34	7,34
60	6,34	6,25	6,25	5,99	6,26	6,21	6,25	6,25

STRAWS

Straws – is the second type of solid biomass resources in Lithuania.

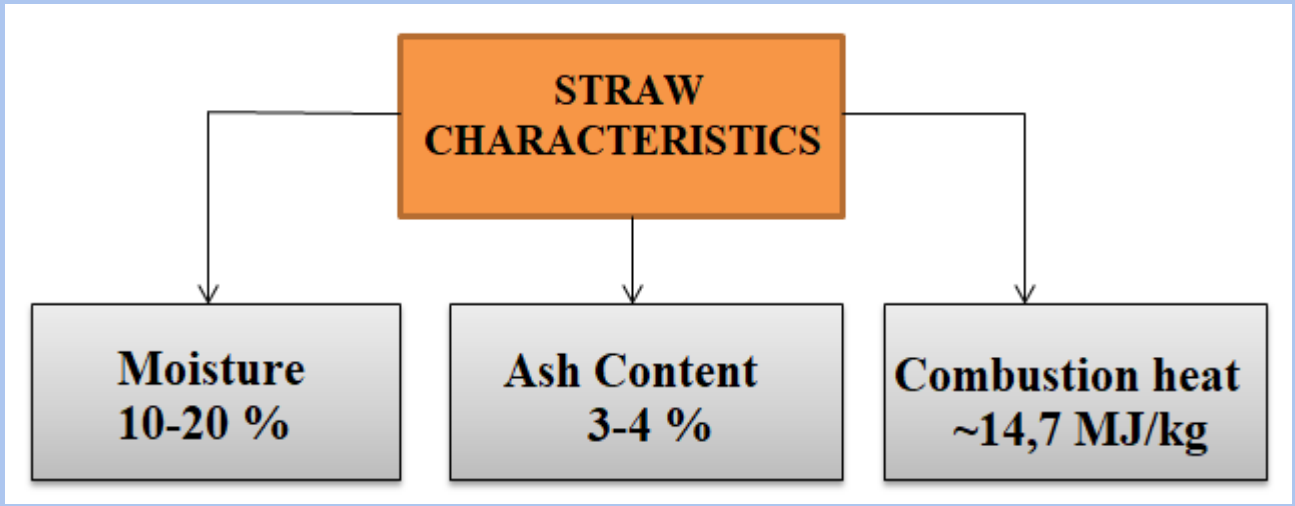

Fig. 14. The main indicators of straw

Fig.15. Straws
http://www.delfi.lt/verslas/energetika/ar-siaudai-taps-lietuvos-nafta.d

By burning straws, emmitted CO_2 is compensated by amount of CO_2, which is been absorbed by growing corn.

It can be stated, that by replacing fossil fuel with straws, CO_2 is reduced as greenhouse gas effect emission.

Elemental composition of straw's dry mass and combustion heat slightly differs from corresponding wood indicators, but combustion heat is slightly lower, [R.2]:

Table 3

Elemental composition	Amount of elements in dry mass, %	Average
C	45-47	46
H	5,8-6,0	5,9
O	0,4-0,6	0,5
N	39-41	40
S	0,01-0,13	0,08
Cl	0,14-0,97	0,31

Pellets produced from straws can be compressed with binding material – molasses, which improves adhesion of pellets and reduces ash content.

Lower calorific heat value of fuel for dry mass varies from 16,7 MJ/kg to 17,8 MJ/kg.

The calorific value of straw pellets is lower than coals, natural gas and wood pellets.

Ash of burnt straw becomes natural fertilizer, and can be used in fields.

It is widely used in Poland, Germany and in most advanced Scandinavian countries in Europe.

Peats

Peat – is an organic material, originated from not fully decomposed plants, wood residues and humus.

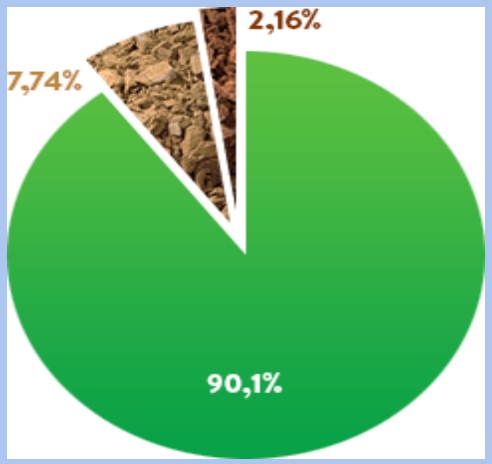

Fig. 16. Peat resources in Lithuania
http://www.bioenergija.lt/lt/i/produktai/faktai-apie-kuro-durpes/

The most important indicators of peats:

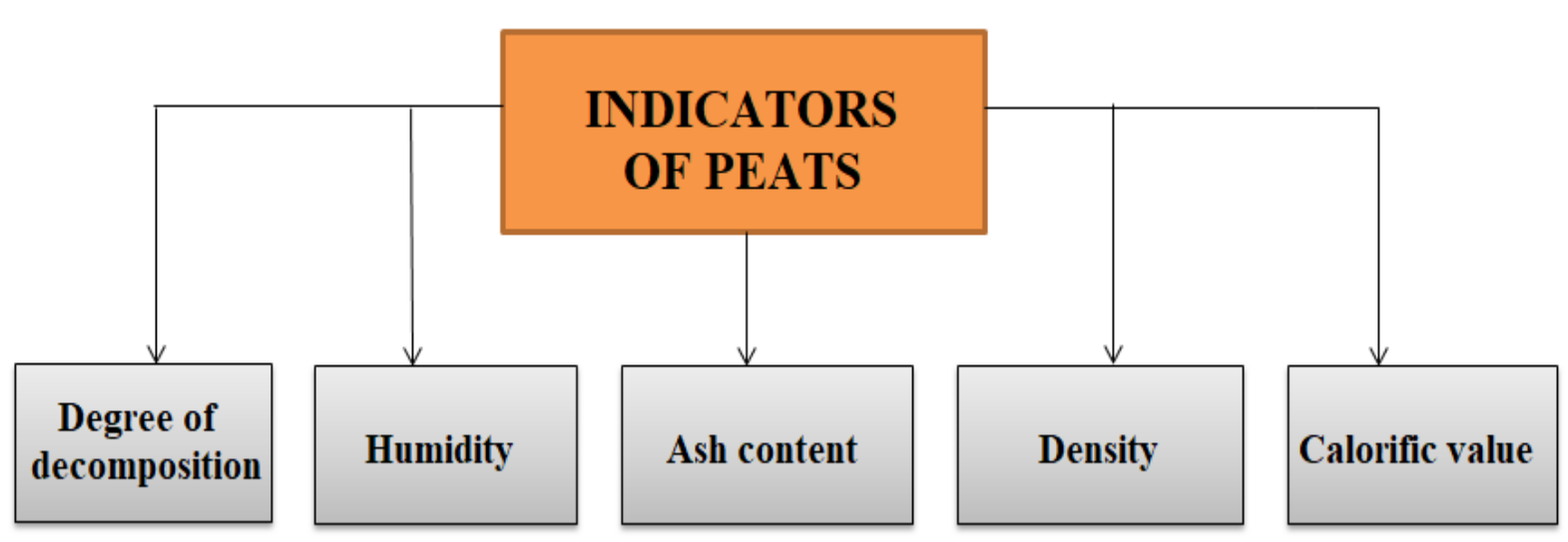

Fig. 17. The main indicators of peat

The main types of peat:

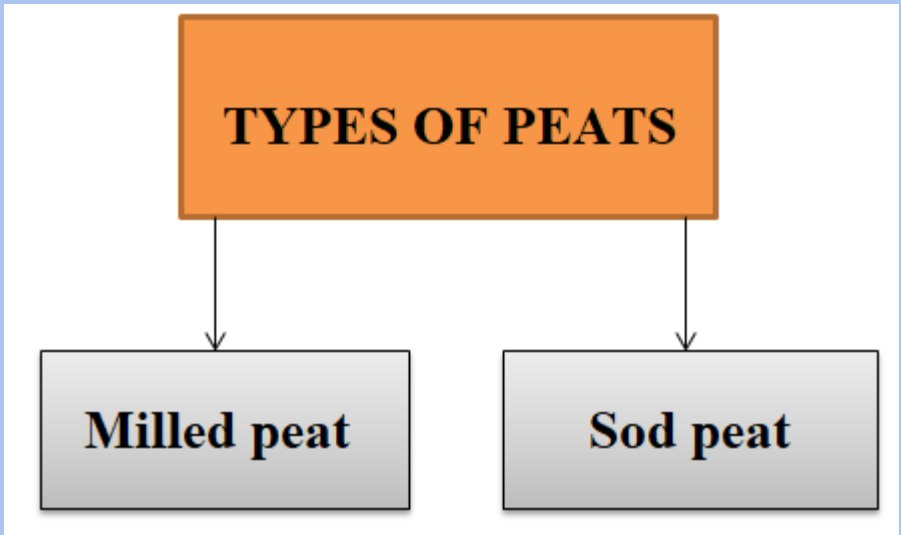

Fig. 18. Peat types

Peat fuel composition:

- Ash content (4-6%);
- The amount of bound carbon C in dry matter (23-31%);
- The amount of volatile substances in dry matter (65-70%);

- Humidity of used mass:

a) milled peat – an average of 48 %;

b) sod peat – an average 35 %;

c) peat briquettes – an average of 10%.

Milled peat fuel – peats, fired in boiler houses of industrial and larger objects, by adapting mouths for use of this fuel.

Fig. 19. Milled peats
http://www.bioenergija.lt/lt/i/produktai/trupinines-kuro-durpes/

Milled fuel peats are gained by crushing upper surface layer of peat bog and leaving it to dry on the surface.

Milled peats are composed of various sizes of particles, but their basis is composed of powder-like particles.

Fuel peats – are eco-friendly fuel, suitable for burning solid fuel in adapted heating boilers.

According to the calorific capacity is equivalent to wood.

In the elemental composition of these peats carbon (up to 65%) and oxygen (30%) are predominant.

Fig.20. Sod peats
http://www.bioenergija.lt/lt/i/produktai/trupininės-kuro-durpes/

These peats are dried up to 22% of moisture, after that under the presses peat semibriquettes are formed in 180 x 80 x (30-70) mm.

Fig. 21. Peat products
http://www.rekyva.eu/lt/produktai/

In chemical element composition carbon and oxygen are predominant:

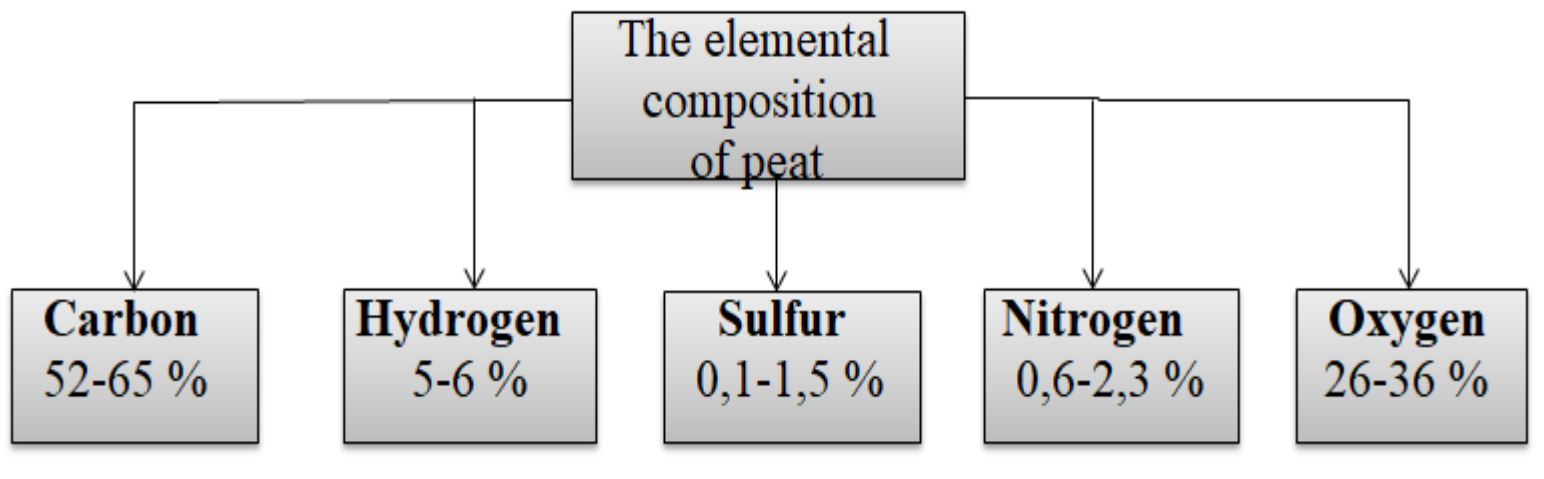

Fig. 22. Peat chemical element composition

The ignition temperature of peats – 225°C.

Peat pellets distinguishes high calorific value (15.MJ) and low cost.

Fig. 23. Peat pellets
http://gerosgranules.lt/durpiu-granules.html

References

1. *Biomasės panaudojimo galimybės energijos gamybai CŠT sektoriuje (The usage possibilities of biomass energy production in CHNB sector).* Paruošė A. Jakštas. Vilnius, 2011.
2. Kytra, S. *Atsinaujinantys energijos šaltiniai (Renewable Energy Resources).* Kaunas: Technologija, 2006.
3. *Lietuvos Respublikos Atsinaujinančių išteklių energetikos įstatymas (Republic of Lithuania Law Renewable Energy*). 2011-05-26 No. 62-2936. Aktuali redakcija nuo 2016-03-0.
4. http://biokuras.lt/uploads/new_assigned_files/1.%20Egidijus%20Puida.%20Sekcija%20B.pdf.
5. http://www.agroakademija.lt/inzinerija/energetika/?SId=1183
6. http://energetikosabc.lt/lt/atsinaujinantys-istekliai/kokios-yra-biokuro-rusys/biodegalai/158

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