



# KARAKTERISTIKE ČVRSTIH BIOGORIVA

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HEP-Proizvodnja d.o.o.  
Centralni- kemijsko tehnološki laboratorij (CKTL)  
Zagorska 1  
Zagreb



# CENTRALNI KEMIJSKO-TEHNOLOŠKI LABORATORIJ (CKTL)




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opisanoj prema zahtjevnim normama  
is conforming according to  
HRN EN ISO/IEC 17025:2007  
(ISO/IEC 17025:2005+Cor 1:2006)  
EN ISO/IEC 17025:2005+AC:2006  
as/to carry out

ispitivanje ložnog ulja, ugljena, koksa i čvrstih biogoriva  
Testing of fuel oil, coal, coke and solid biofuels

u području opisanom u prilozi koji je sastavni dio ove potvrde o akreditaciji  
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Klasa/Class: 03/02/10-01/025  
Udioj/kid.Nr.: 03/02/10-01/025  
Zagreb, 03/02/2013

Akreditacija istječe/Accreditation expiry: 03/02/2015  
Prva akreditacija/initial accreditation: 03/02/2013

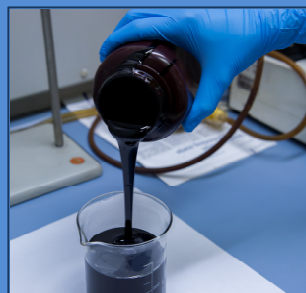
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LOŽIVA ULJA



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KOKS



ČVRSTA BIOGORIVA



# ŠTO PROPISUJE KVALITETU ČVRSTIH BIOGORIVA?

The image displays seven overlapping pages of Croatian standards (HRVATSKA NORMA) for solid biomass fuels, all based on the EN ISO 17225 series. The standards are:

- HRVATSKA NORMA HRN EN ISO 17225-1**: Čvrsta biogoriva – Specifikacije goriva i razredi – 1. dio: Opći zahtjevi (ISO 17225-1:2014; EN ISO 17225-1:2014). Solid biofuels – Fuel specifications and classes – Part 1: General requirements (ISO 17225-1:2014; EN ISO 17225-1:2014).
- HRVATSKA NORMA HRN EN ISO 17225-2**: Čvrsta biogoriva – Specifikacije goriva i razredi – 2. dio: Klasifikacija drvnih peleta (ISO 17225-2:2014; EN ISO 17225-2:2014). Solid biofuels – Fuel specifications and classes – Part 2: Graded wood pellets (ISO 17225-2:2014; EN ISO 17225-2:2014).
- HRVATSKA NORMA HRN EN ISO 17225-3**: Čvrsta biogoriva – Specifikacije goriva i razredi – 3. dio: Klasifikacija drvnih sječke (ISO 17225-3:2014; EN ISO 17225-3:2014). Solid biofuels – Fuel specifications and classes – Part 3: Graded wood chips (ISO 17225-3:2014; EN ISO 17225-3:2014).
- HRVATSKA NORMA HRN EN ISO 17225-4**: Čvrsta biogoriva – Specifikacije goriva i razredi – 4. dio: Klasifikacija drvene sječke (ISO 17225-4:2014; EN ISO 17225-4:2014). Solid biofuels – Fuel specifications and classes – Part 4: Graded wood chips (ISO 17225-4:2014; EN ISO 17225-4:2014).
- HRVATSKA NORMA HRN EN ISO 17225-5**: Čvrsta biogoriva – Specifikacije goriva i razredi – 5. dio: Klasifikacija opjevnog drveta (ISO 17225-5:2014; EN ISO 17225-5:2014). Solid biofuels – Fuel specifications and classes – Part 5: Graded firewood (ISO 17225-5:2014; EN ISO 17225-5:2014).
- HRVATSKA NORMA HRN EN ISO 17225-6**: Čvrsta biogoriva – Specifikacije goriva i razredi – 6. dio: Klasifikacija nedrvenih peleta (ISO 17225-6:2014; EN ISO 17225-6:2014). Solid biofuels – Fuel specifications and classes – Part 6: Graded non-woody pellets (ISO 17225-6:2014; EN ISO 17225-6:2014).
- HRVATSKA NORMA HRN EN ISO 17225-7**: Čvrsta biogoriva – Specifikacije goriva i razredi – 7. dio: Klasifikacija nedrvenih briкета (ISO 17225-7:2014; EN ISO 17225-7:2014). Solid biofuels – Fuel specifications and classes – Part 7: Graded non-woody briquettes (ISO 17225-7:2014; EN ISO 17225-7:2014).

Each page includes the HZN logo and the text: "Hrvatski zavod za norme, Zagreb, Hrvatska". The standards are published by HZN, Hrvatski zavod za norme, Zagreb, Hrvatska.

# DRVNI PELETI

Table 2 — Specification of graded wood pellets for industrial use

Property class, Analysis method	Unit	I1			I2			I3					
		1			2			1			2		
<b>Normative</b> Origin and source, ISO 17225-1		1.1 Forest, plantation and other virgin wood 1.2.1 Chemically untreated wood residues <sup>a</sup>			1.1 Forest, plantation and other virgin wood 1.2.1 Chemically untreated wood residues <sup>a</sup>			1.1 Forest, plantation and other virgin wood 1.2 By-products and residues from wood processing industry 1.3.1 Chemically untreated used wood					
Diameter, D <sup>b</sup> and Length L, c, ISO 17829 According Figure 1	mm	D06, 6 ± 1; 3.15 < L ≤ 40 D08, 8 ± 1; 3.15 < L ≤ 40			D06, 6 ± 1; 3.15 < L ≤ 40 D08, 8 ± 1; 3.15 < L ≤ 40 D10, 10 ± 1; 3.15 < L ≤ 40			D06, 6 ± 1; 3.15 < L ≤ 40 D08, 8 ± 1; 3.15 < L ≤ 40 D10, 10 ± 1; 3.15 < L ≤ 40 D12, 12 ± 1; 3.15 < L ≤ 40					
Moisture, M, ISO 18134-1, ISO 18134-2	w-% as received, wet basis	M10 ≤ 10			M10 ≤ 10			M10 ≤ 10					
Ash, A, ISO 18122	w-% dry	A1.0 ≤ 1.0			A1.5 ≤ 1.5			A3.0 ≤ 3.0					
Mechanical durability, DU, ISO 17831-1	w-% as received	97.5 ≤ DU ≤ 99.0			97.0 ≤ DU ≤ 99.0			96.5 ≤ DU ≤ 99.0					
Fines, F <sup>d</sup> , ISO 18846	w-% as received	F4.0 ≤ 4.0			F5.0 ≤ 5.0			F6.0 ≤ 6.0					
Additives <sup>e</sup>	w-% as received	< 3 Type and amount to be stated			< 3 Type and amount to be stated			< 3 Type and amount to be stated					
Net calorific value, Q, ISO 18125	MJ/kg as received	Q16.5 ≥ 16.5			Q16.5 ≥ 16.5			Q16.5 ≥ 16.5					
Bulk density, BD <sup>f</sup> , ISO 17828	kg/m <sup>3</sup>	BD600 ≥ 600			BD600 ≥ 600			BD600 ≥ 600					
Nitrogen, N, ISO 16948	w-% dry	N0.3 ≤ 0.3			N0.3 ≤ 0.3			N0.6 ≤ 0.6					
Particle size distribution of disintegrated pellets, ISO 17830	w-% equilibrated basis	≥ 99 % (<3.15 mm) ≥ 95 % (<2.0 mm) ≥ 60 % (<1.0 mm)			≥ 98 % (<3.15 mm) ≥ 90 % (<2.0 mm) ≥ 50 % (<1.0 mm)			≥ 97 % (<3.15 mm) ≥ 85 % (<2.0 mm) ≥ 40 % (<1.0 mm)					
Sulfur, S, ISO 16994	w-% dry	S0.05 ≤ 0.05			S0.05 ≤ 0.05			S0.05 ≤ 0.05					
Chlorine, Cl, ISO 16994	w-% dry	Cl0.03 ≤ 0.03			Cl0.05 ≤ 0.05			Cl0.1 ≤ 0.1					
Arsenic, As, ISO 16968	mg/kg dry	≤ 2			≤ 2			≤ 2					
Cadmium, Cd, ISO 16968	mg/kg dry	≤ 1.0			≤ 1.0			≤ 1.0					
Chromium, Cr, ISO 16968	mg/kg dry	≤ 15			≤ 15			≤ 15					
Copper, Cu, ISO 16968	mg/kg dry	≤ 20			≤ 20			≤ 20					
Lead, Pb, ISO 16968	mg/kg dry	≤ 20			≤ 20			≤ 20					
Mercury, Hg, ISO 16968	mg/kg dry	≤ 0.1			≤ 0.1			≤ 0.1					
Zinc, Zn, ISO 16968	mg/kg dry	≤ 200			≤ 200			≤ 200					

Table 2 (continued)

Property class, Analysis method	Unit	I1			I2			I3					
		1			2			1			2		
<b>Informative</b> Ash melting behaviour <sup>g</sup> , CEN/TS 15370-1 (M)	°C	Should be stated			Should be stated			Should be stated					

<sup>a</sup> Negligible levels of glue, grease and other timber production additives used in sawmills during production of timber and timber product from virgin wood are acceptable if all chemical parameters of the pellets are clearly within the limits and/or concentrations are too small to be concerned with.

<sup>b</sup> Selected size D06, D08, D10 or D12 of pellets to be stated.

<sup>c</sup> Amount of pellets longer than 40 mm can be 1 w-%. Maximum length shall be ≤ 45 mm. Pellets are longer than 3.15 mm, if they stay on a round hole-sieve of 3.15 mm. Amount of pellets shorter than 10 mm, w-% recommended to be stated.

<sup>d</sup> At factory gate in bulk transport (at the time of loading) and large sacks (at time of packing or when delivering to end-user).

<sup>e</sup> Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin).

<sup>f</sup> Maximum bulk density is 750 kg/m<sup>3</sup>.

<sup>g</sup> It is recommended that all characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT)) in oxidizing conditions should be stated.

# SJEČKA

Table 2 — Specification of graded wood chips

Property class, Analysis method	Unit	A		B	
		1	2	1	2
<b>Normative</b> Origin and source, ISO 17225-1		1.1.1 Whole trees without roots <sup>a</sup> 1.1.3 Stemwood 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues		1.1.1 Whole trees without roots <sup>a</sup> 1.1.3 Stemwood 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues	
Particle size, P, ISO 17827-1	mm	to be selected from Table 1		to be selected from Table 1	
Moisture, M <sup>c</sup> , ISO 18134-1, ISO 18134-2	w-%	M10 ≤ 10 M25 ≤ 25	M35 ≤ 35	Maximum value to be stated	
Ash, A, ISO 18122	w-% dry	A1.0 ≤ 1.0	A1.5 ≤ 1.5	A3.0 ≤ 3.0	
Bulk density, BD <sup>d</sup> , ISO 17828	kg/loose m <sup>3</sup> as received	BD150 ≥ 150 BD200 ≥ 200 BD250 ≥ 250	BD150 ≥ 150 BD200 ≥ 200 BD250 ≥ 250 BD300 ≥ 300	Minimum value to be stated	
Nitrogen, N, ISO 16948	w-% dry	Not applicable	Not applicable	N1.0 ≤ 1.0	
Sulfur, S, ISO 16994	w-% dry	Not applicable	Not applicable	S0.1 ≤ 0.1	
Chlorine, Cl, ISO 16994	w-% dry	Not applicable	Not applicable	Cl0.05 ≤ 0.05	
Arsenic, As, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 1	
Cadmium, Cd, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 2.0	
Chromium, Cr, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 10	
Copper, Cu, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 10	
Lead, Pb, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 10	
Mercury, Hg, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 0.1	
Nickel, Ni, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 10	
Zinc, Zn, ISO 16968	mg/kg dry	Not applicable	Not applicable	≤ 100	

Table 2 (continued)

Property class, Analysis method	Unit	A		B	
		1	2	1	2
<b>Informative</b> Net calorific value, Q <sup>e</sup> , ISO 18125	MJ/kg or kWh/kg as received	Minimum value to be stated		Minimum value to be stated	

<sup>a</sup> Excluding class the separation or chemical proc

Table 1 — Particle size of graded wood chips

Dimensions (mm), ISO 17827-1				
Main fraction <sup>a</sup> (minimum 60 w-%), mm	Fines fraction, w-% (≤3.15 mm)	Coarse fraction, w-% (length of particle, mm)	Max. length of particles <sup>b</sup> , mm	Max. cross sectional area of the coarse fraction <sup>c</sup> , cm <sup>2</sup>
P165 3.15 mm < P ≤ 16 mm	≤ 15 %	≤ 6 % (>3.15 mm)	≤ 45 mm	≤ 2 cm <sup>2</sup>
P315 3.15 mm < P ≤ 31.5 mm	≤ 10 %	≤ 6 % (>45 mm)	≤ 150 mm	≤ 4 cm <sup>2</sup>
P455 3.15 mm < P ≤ 45 mm	≤ 10 %	≤ 10 % (>63 mm)	≤ 200 mm	≤ 6 cm <sup>2</sup>

<sup>a</sup> The numerical values (P-class) for dimension refer to the particle sizes passing through the mentioned round hole sieve size (ISO 17827-1). The lowest possible class should be stated. Only one class shall be specified for wood chips.

<sup>b</sup> Length and cross sectional area only have to be determined for those particles, which are to be found in the coarse fraction. Maximum 2 pieces of about 10 l sample may exceed the maximum length, if the cross sectional area is < 0.5 cm<sup>2</sup>.

<sup>c</sup> For measuring the cross sectional area it is recommended to use a transparent set square, place the particle orthogonally behind the set square and estimate the maximum cross sectional area of this particle with the help of the cm<sup>2</sup>-pattern.

# ZAŠTO ODREĐIVATI KVALITETU ČVRSTIH BIOGORIVA?

*Kvaliteta je prikladnost za upotrebu (Joseph M. Juran)*

*Kvaliteta je sprečavanje pogrešaka (W. Edwards Deming)*

*Kvaliteta je udovoljavanje zahtjevima (Philip Crosby)*

*Kvaliteta je raditi dobro kad nitko ne gleda (Henry Ford)*

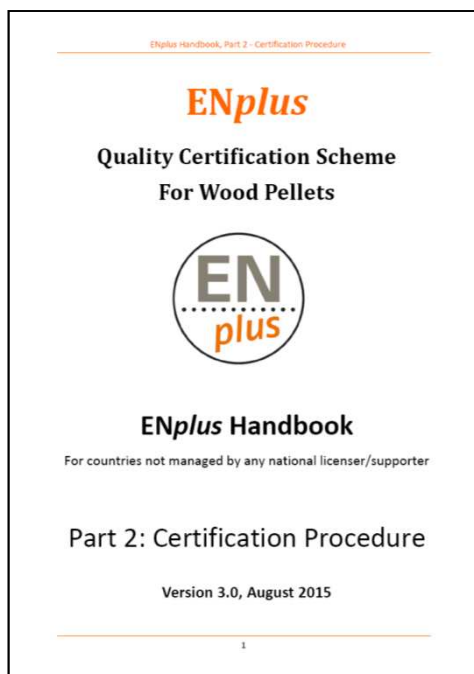
*Preuzeto iz knjige: Plivati s ISO-om i ostati živ, autorice: Olge Štajdohar- Pađen*

1. Certifikacija proizvoda, kontrola proizvodnje i procesa
2. Pojedinačno ili kontinuirano utvrđivanje kvalitete (npr. zahtjevi kupca, poboljšanje procesa proizvodnje)



# CERTIFIKACIJSKE SCHEME

**13** CERTIFICIRANIH PROIZVOĐAČA PELETA IZ HRVATSKE (što je više od Belgije (5), Danske (1), Finske (0), Estonije(8) , Francuske (11), Irske (1), Slovenije (3), Slovačke (7), Švedske (1), Švicarske (7), Nizozemska (1), Velike Britanije (8))



Inspekcijska tijela: <http://www.enplus-pellets.eu/production/inspection-bodies/>

Certifikacijsko tijelo  
<http://www.enplus-pellets.eu/production/certification-bodies/>

Ispitno tijelo/ Laboratorij  
<http://www.enplus-pellets.eu/production/testing-bodies/>

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# CERTIFIKACIJSKE SCHEME

## 1 CERTIFICIRANI PROIZVOĐAČ PELETA IZ HRVATSKE

Certification scheme wood pellets for use in small furnaces. DINplus Page 1 of 17.

**Certification Scheme**

Wood pellets for use in small furnaces

In accordance with

**DIN EN ISO 17225-2 (A1)**

(Edition: June 2015)

DIN CERTCO • Albinstraße 64 • 12103 Berlin  
 Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dinertco.de

DIN CERTCO  
 Iss. Edition: 06.10.19rev: 20.03.2014

Certification Scheme „Wood briquettes“ page 1 of 11.

**Certification Scheme**

Wood briquettes

according to

**DIN EN 14961-3**

(Edition: September 2011)

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DIN CERTCO  
 Iss. Edition: 06.11.19rev: 03.08.2017

### Cijena certifikacije:


- Cijena najviše ovisi o lokaciji proizvođača.
- 3000-4000 Eura godišnje za proizvođača u Njemačkoj
- Certifikat je potrebno svake godine obnavljati.







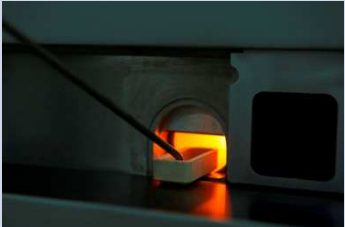
# PREGLED KARAKTERISTIKA(1)

PARAMETAR	OPIS
<b>PRIPREMA UZORAKA ZA ANALIZU</b>	<ul style="list-style-type: none"><li>• Razdjeljivanje</li><li>• Sušenje na 110°C do konstantne mase (<b>određivanje ukupne vlage</b>)</li><li>• Mljevenje</li><li>• Razdjeljivanje- homogeni i reprezentativni uzorak</li></ul>    



# PREGLED KARAKTERISTIKA(2)

PARAMETAR	OPIS	
<b>DIMENZIJE</b> (promjer i duljina) (peleti i briketi)		 <p>Figure 2 – Examples of briquettes</p>
<b>PEPEO</b>		žarenjem u peći na 250→550°C do konstantne mase
<b>MEHANIČKA IZDRŽLJIVOST</b> (peleti i briketi) <i>Mjera otpornosti peleta ili briketa prema šokovima ili abraziji tijekom postupaka rukovanja i transporta.</i>		
<b>FINOĆA</b> (peleti)		Prosijavanjem kroz sito 3,15 mm
<b>OGRJEVNA VRIJEDNOST</b> Potrebno je poznavati: - CHNS, pepeo i vlagu		spaljivanjem u kalorimetrijskoj bombi

# PREGLED KARAKTERISTIKA (3)

PARAMETAR	OPIS
<b>NASIPNA GUSTOĆA</b> (peleti i sječka) <i>Masa količine goriva podijeljenog sa volumenom posude pod određenim uvjetima.</i>	 A photograph showing a laboratory setup for density measurement. It includes a digital scale on a red mat, a wooden beam, and a metal container on a white surface.
<b>SADRŽAJ DUŠIKA</b>	<p>-CHN analiza- spaljivanjem na 950°C</p>   Two photographs illustrating the CHN analysis process. The left photo shows a technician in a white lab coat operating a large analytical instrument. The right photo is a close-up of a hand placing a sample into a small container on a tray.
<b>SADRŽAJ SUMPORA</b>	<p>- Spaljivanjem u struji kisika 1350°C</p>   Two photographs illustrating the sulfur analysis process. The left photo shows a technician in a white lab coat operating a large analytical instrument. The right photo is a close-up of a high-temperature furnace with a glowing orange interior.

# PREGLED KARAKTERISTIKA (4)

PARAMETAR	OPIS
<b>SADRŽAJ KLORA</b>	 <p>XRF spektrometrom</p>
<b>SADRŽAJ SPOREDNIH I ELEMENATA U TRAGOVIMA</b> (As, Cd, Cr, Cu, Pb, Ni, Zn)	<p>Razlaganjem mikrovalnom digestijom i analizom na ICP-OES-u</p>  
<b>SADRŽAJ ŽIVE</b>	 <p>Direktnim određivanjem primjenom principa termičke razgradnje, amalgamiranja i atomske apsorpcije.</p>

# PREGLED KARAKTERISTIKA (5)

## PARAMETAR

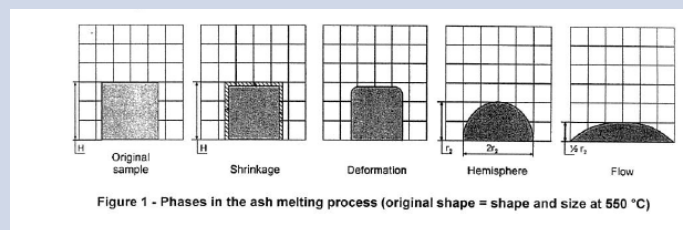
### ODREĐIVANJE TEMPERATURE TALJENJA PEPELA

4 karakteristične temperature:

- SST – temperatura početnog skupljanja
- DT – temperatura deformacije
- HT – hemisferna temperatura
- FT – temperatura tečenja

## OPIS

- 4 karakteristične temperature, do 1500°C



*Slika preuzeta iz norme CEN/TS 15370-1:2006*

# PREGLLED KARAKTERISTIKA (6)

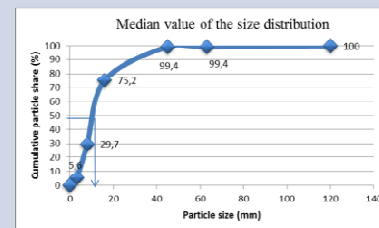
## PARAMETAR

**VELIČINA ČESTICA**  
(sječka)

Šumarski fakultet Sveučilišta u Zagrebu  
Laboratorij za biomasu  
Prof.dr.sc. Zečić

## OPIS

- Prosijavanjem kroz sita različitih otvora



Tablica: Usporedba rezultata ispitivanja različitih vrsta čvrstih biogoriva

ZNAČAJKE KVALITETE	Jedinice	PELETI	BRIKETI	SJEČKA
<b>Mehanička izdržljivost</b> (dostavno stanje)	mas.%	<b>96,4</b>	<b>92,8</b>	---
<b>Nasipna gustoća</b> (dostavno stanje)	kg/m <sup>3</sup>	<b>650</b>	-----	<b>220</b>
<b>Gustoća čestica</b> (dostavno stanje)	g/cm <sup>3</sup>	<b>1,29</b>	<b>1,00</b>	-----
<b>Ukupna vlaga</b> (dostavno stanje)	mas.%	<b>4,1</b>	<b>3,9</b>	<b>57,2</b>
<b>Sadržaj pepela</b> (suho stanje)	mas.%	<b>1,5</b>	<b>2,0</b>	<b>6,7</b>
<b>Hlapive tvari</b> (suho stanje)	mas.%	<b>81,2</b>	<b>81,8</b>	<b>77,3</b>
<b>Sadržaj ugljika</b> (suho stanje)	mas.%	<b>50,0</b>	<b>49,6</b>	<b>47,4</b>
<b>Sadržaj vodika</b> (suho stanje)	mas.%	<b>5,9</b>	<b>5,9</b>	<b>5,6</b>
<b>Sadržaj dušika</b> (suho stanje)	mas.%	<b>0,2</b>	<b>0,14</b>	<b>0,4</b>
<b>Sadržaj sumpora</b> (suho stanje)	mas.%	<b>0,032</b>	<b>0,03</b>	<b>0,147</b>
<b>Ogrjevna vrijednost gornja</b> (suho stanje)	MJ/kg	<b>19,87</b>	<b>19,60</b>	<b>18,79</b>
<b>Ogrjevna vrijednost donja</b> (suho stanje)	MJ/kg	<b>18,58</b>	<b>18,31</b>	<b>17,57</b>

CENTRALNI KEMIJSKO-  
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