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Energy Evaluation of Biomass Compaction Technique: A Review

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***Abstract*— Biomass compacting addresses innovation for the change of biomass into a strong biomass fuel fit as a fiddle of briquettes and pellets. Recently hacked tail biomass is the material of low mass thickness (80 – 150 kg m-3), therefore compacting of biomass is one of the significant cycles for viable taking care of, transport and capacity of this biomass fuel material. This investigation was led to assess two biomass compacting systems – water driven cylinder press, and screw press. Specialized boundaries of these two kinds of presses were broke down. The energy utilization for strong wood fuel mass unit creation in briquetting measure is utilized as the fundamental rule. The key objective is to track down the most helpful compaction instrument for energy crop portable briquetting press plan.**

Keywords—Biomass, briquettes, pellets, wood fuel, fuel energy

I. Introduction

After coal and oil, biomass is the third biggest energy asset on the planet. Until the mid-nineteenth century, biomass ruled worldwide energy utilization. Indeed, despite the fact that expanded fossil – fuel use has provoked a decrease in biomass utilization for energy purposes in the course of recent years, biomass actually gives about 1.25 billion tons of oil same (Btoe) or about 14% of the world's yearly energy utilization (Parikka M., 2004; Tumuluru J.S., 2010).

Wood energizes, agrarian straws, and energy crops are the most noticeable biomass fuel sources. In Latvia, around 14.6% of unfarmed agrarian land can be utilized for herbaceous energy crop developing. Herbaceous energy harvests would be the primary reason for strong biofuel creation in farming environment in future. Herbaceous energy crops – reed canary grass (Phalaris around in acea) and hemp (Cannabis sativa) have been filled lately. Alongside that there is probability to use for bioenergy creation normal biomass of regular reeds (Phragmites Australis) congesting shorelines of Latvian more than 2000 lakes. Biomass compacting addresses innovation for the change of biomass into a strong biomass fuel fit as a fiddle of briquettes and pellets. Recently slashed tail biomass is the material of low mass thickness (80 – 150 kg m-3), consequently compacting of biomass is one of the significant cycles for successful taking care of, transport and capacity of this biomass fuel material.

Pelleting, briquetting, and expulsion handling are strategies ordinarily used to accomplish densification. The present paper manages assessment of two regularly utilized biomass densification systems – pressure driven After coal and oil; biomass is the third biggest energy asset on the planet. Until the mid-nineteenth century, biomass ruled worldwide energy utilization. Indeed, despite the fact that expanded fossil – fuel use has provoked a decrease in biomass utilization for energy purposes in the course of recent years, biomass actually gives about 1.25 billion tons of oil same (Btoe) or about 14% of the world's yearly energy utilization (Parikka M., 2004; Tumuluru J.S., 2010).

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II. Materials and Methods

The specialized information from producers of 15 screw presses and 15 water driven cylinder presses were analyzed. The energy utilization of screw press and water driven cylinder press for biomass unit briquetting was determined by Formula:

$$E_{sc} = 3600/Q \qquad (1)$$

Where,

Esc – specific energy of compacting mechanism, kJ kg^{-1}.

P – power of compacting mechanism, kW.

Q – capacity of compacting mechanisms, kg h^{-1}.

For thickness assurance, sawdust briquettes were acquired tentatively during compacting (Figure 1) with screw press and water driven cylinder press. Specialized boundaries of the water driven cylinder press: admissible dampness of info material 8 – 18%; thickness of created briquettes 600 – 1100 kg m-3; maximal water driven pressing factor 18 MPa; limit 30 – 60 kg h-1; power 4 kW. Specialized boundaries of the screw press: reasonable dampness of info material 8 – 10%; thickness of created briquettes 900 – 1400 kg m-3; limit 250 – 300 kg h-1; power 22 kW; force of electric radiator 6 kW. The sawdust briquettes made with screw press had a hexagon cross-area with normal edge measurement of 46 mm furthermore, with inward opening Ø20 mm. The sawdust briquettes made with pressure driven cylinder press had a round cross section with normal breadth of 64.5 mm and square structure with edges measurement 64 x 150 mm.

Figure 1. Equipment for briquetting experiments

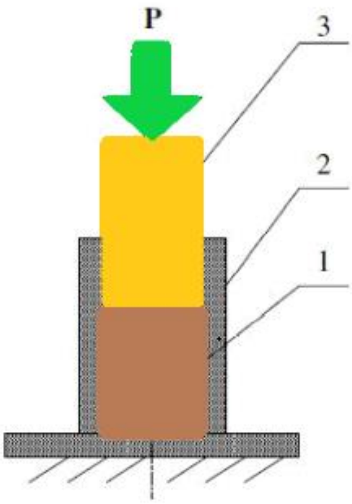

Figure 2. The closed die for compacting: 1 – biomass, 2 – cylinder, 3 – piston

Briquettes densities were resolved from the proportion of the mass to the volume of the briquette. For thickness computation the heaviness of briquette was estimated on electronic scales Sartorius GM312 with a division of 0.01 g, and size of briquettes was estimated with sliding calipers (division 0.01 mm). Lab compaction tests were conveyed out in a shut pass on with width of 35 mm by implies of

water driven press hardware (Figure 2). A cleaved normal reed and reed-peat combination material was utilized for tests. For reed-peat blend, peat was included 15, 30 and half extent. The adjusted wood shredder Tuenniseen GM-10 was utilized for reed slashing. The dampness content was resolved as indicated by the standard BS EN 14774-2:2009, where broiler drying of the examples was done at 105 ± 2ºC (BS EN 14774-2, 2009). The measurements of
35 grams of slashed basic reed particles and a combination with peat added substance was utilized for each briquette squeezing. During compacting of individual briquette, the power dislodging information were recorded by Pico Information Logger and PC. Energy prerequisite for compacting was acquired from power dislodging bends by graphical coordination. The normal upsides of estimations were determined from 11 repeats.

III. Results and Discussion

The specialized information from producers of 15 screw presses and 15 water powered cylinder presses and explicit energy utilization computation for wood biomass unit briquetting are introduced in Table 1 and Table 2. From the got results, for the screw press the determined insignificant normal explicit energy is 350 kJ kg-1, maximal – 504 kJ kg-1 yet for water driven cylinder press the negligible normal explicit energy is 275 kJ kg-1, maximal 424 kJ kg-1. The energy contrasts rely upon the insignificant and maximal limits of presses. Normal explicit compacting energy for the gathering of 15 screw presses is 407 kJ kg-1, yet for the gathering of 15 water powered cylinder presses – 350 kJ kg-1. The normal explicit energy utilization contrast of 57 kJ kg-1 between the activity of screw press and water driven cylinder press can be clarified with by extra energy utilization for biomass warming. Accordingly, for versatile briquetting machines the water driven cylinder press component is more ideal. Thickness of sawdust briquettes got during compacting (Figure 3) with screw press and water driven cylinder press was resolved 1122 kg m-3 for screw press briquettes, 902 kg m-3 for water driven cylinder press briquettes with a round cross-segment and 930 kg m-3 with a square cross-area. Thickness of tentatively delivered wood briquettes was contrasted and proposals of the standard LVS EN 14961-3:2011. This norm detail of wood briquettes for non-mechanical use has two gatherings, An and B, with suggested densities DE1.0 ≥ 1.0 g cm3 what's more, DE0.9 ≥ 0.9 g cm3 likewise.
There are no huge contrasts between standard LVS EN 14961-3:2011 thickness suggestions and decided thickness of wood briquettes created with the screw press and the water powered cylinder press. The specialized properties of the water powered cylinder press let to expand thickness of briquettes if grating powers in compaction pass on are broadened.

TABLE I

SCREW PRESS PARAMETERS

Screw press (Machine model)	Power, kW	Power of electric heater, kW	Capacity, kg h^{-1} (Min)	Capacity, kg h^{-1} (Max)	Specific energy, kJ kg^{-1} (Max)	Specific energy, kJ kg^{-1} (Min)	Average specific energy, kJ kg^{-1}
BIOMASSER SOLO BS06	4.2	4.5	40	60	783	522	653
SOLO 50	4.2	4.5	40	50	378	302	340
DUO 100	8.75	5	80	100	619	495	557
ZBJI	11	4.5	80	120	698	465	582
ZBJ-I	11	4.5	150	180	372	310	310
BIOMASSER DUO-SET	12.5	6.6	100	140	688	491	590
ZBJ-15	15	4.5	140	200	501	351	426
ПЭ-4	15	4.5	160	300	439	234	337
ZBJ-III	18.5	6.6	230	280	393	323	358
Zhongda	18.5	6.6	250	350	361	258	310
Hongji	18.5	6.6	250	350	361	258	310
ZBJ-ZY	22	9	320	500	349	223	286
Mingyang	22	6.6	240	320	429	322	376
HJJX-11	22	9	250	300	446	372	409
ПТБ	45	6.6	250	650	743	286	515

Source: Internet Search Results

Figure 4 shows that expanding compacting pressure from 136 to 276 MPa, the densities of reed briquettes are expanding from 956 to 1040 kg m-3.For compacting tests were utilized three pressing factor levels – 136, 206, and 276 MPa. Explicit squeezing energy was expanding from 39 to 47 kJ kg-1, however 1000 kg m-3 thickness was accomplished distinctly for compacting pressure > 200 MPa. The subsequent most noteworthy coefficient of assurance for compacting information R2 was resolved for thickness 0.97 and for explicit squeezing energy 0.88 Figure 5 shows the squeezing energy utilization for briquetting basic reeds with peat added substance of up to half, and the thickness of delivered briquettes.

TABLE II

HYDRAULIC PISTON PRESS PARAMETERS

Hydraulic piston press (Machine model)	Power, kW	Capacity, kg h^{-1} (Min)	Capacity, kg h^{-1} (Max)	Specific energy, kJ kg^{-1} (Max)	Specific energy, kJ kg^{-1} (Min)	Average specific energy, kJ kg^{-1}
BrikStar CS3-12	3	20	40	540	270	405
BrikStar CS4-12	4	30	60	480	240	360
OL.D 52	4	30	50	480	288	384
Weima C140	4	30	40	480	360	420
AECO 30	4.4	20	40	792	396	594
AECO 50	5.4	40	60	486	324	405
Weima C170	5.5	60	80	330	248	289
BP-100	5.6	43	63	469	320	395
Weima TH514	7.5	70	100	386	270	328
OL.D 62	7.5	50	70	540	386	463
BP 2000	18.5	150	225	444	296	370
MAX 350	24	350	500	247	173	210
BP 4000	30	600	750	180	144	162
RUF 600	37	500	600	266	222	244
RUF 1100	55	800	1000	248	198	223

Source: Internet Search Results

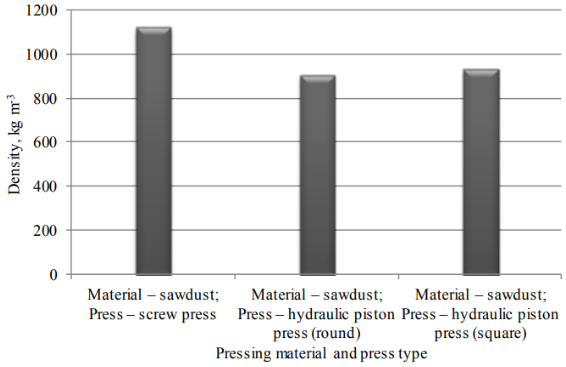

Figure 3. Density of briquettes

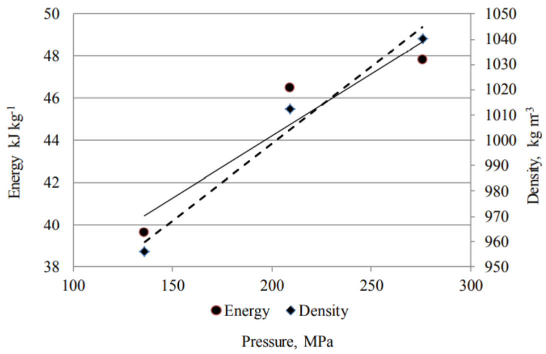

Figure 4. Briquetting energy and briquettes density depending on pressing pressure

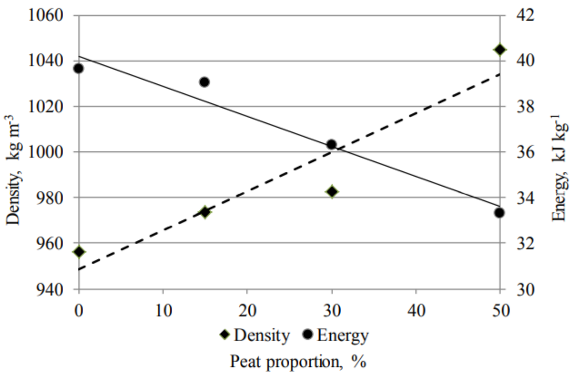

Figure 5. Briquettes density and briquetting energy depending on peat proportion

Greatest pressing factor of 136 MPa was accomplished in compacting. Acquired outcomes show that expanding peat added substance up to half, explicit compacting energy diminished from 39 to 33 kJ kg-1 and thickness expanded from 956 to 1044 kg m-3. The subsequent most noteworthy coefficient of assurance R2 was resolved for thickness 0.95 and for explicit energy 0.89. The current outcomes show that peat added substance is expanding the thickness of normal reed molecule briquettes and is decreasing the compacting energy.

IV. CONCLUSIONS

Normal explicit compacting energy for the explored gathering of 15 screw presses was 407 kJ kg-1, however for the gathering of 15 water powered cylinder presses – 350 kJ kg-1. The normal explicit energy utilization contrast of 57 kJ kg-1 between the activity of screw press and water driven cylinder press can be clarified by extra energy utilization for biomass warming. In this manner, for portable briquetting machines the water driven cylinder press component is more ideal. There were no huge contrasts between the standard LVS EN 14961- 3:2011 thickness suggestions (DE1.0 ≥ 1.0 g cm3 also, DE0.9 ≥ 0.9 g cm3) and the decided thickness of wood briquettes created with the screw press and water driven cylinder press. The specialized properties of water powered cylinder press permit expanding the thickness of briquettes if grinding powers in compaction bite the dust are developed. By expanding the compacting pressing factor of regular reed particles from 136 to 276 MPa, the densities of reed briquettes were expanding from 956 to 1040 kg m-3. Concurring to this pressing factor change, the particular squeezing energy was expanding from 39 to 47 kJ kg-1, yet 1000 kg m-3 thickness was accomplished uniquely for compacting pressure > 200 MPa.Expanding peat added substance up to half to normal reed particles explicit compacting energy diminished from 39 to 33 kJ kg-1 and thickness of briquettes expanded from 956 to 1044 kg m-3. Peat added substance is expanding the thickness of basic reed molecule briquettes and is lessening the explicit compacting energy.

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