"Energy conservation innovative coal-fired technology-NOVENER project"

Innovation project coal burning technology

SCIENTIFIC AND TECHNICAL REPORT

Year 1 operating systems

Cap 1 Technical data of investments

Slag is a waste coarse resulting in combustion of coal grates afterburner located at the base of the boilers on lignite incandescent flowing into the drum with water under outbreak. There is extracted with bands inclined scraper. Unfired clay usually contains mechanical and chemical incomplete, representing on average 3% of the amount of coal consumed by boilers. The project aims at developing an efficient method of recovering these unburnt combustible materials.

Previous experience of Govora in this method by the recovery of slag from the boiler 7 has been improved and applied to the other two boilers coal (C5 and C6) and compelatata with a dispenser particularly alternative fuel solid bands on supply coal boiler.

Takeover slag is made from strips scraper boiler before discharge canal technological exhaust waste as slurry through amlsarea strip pickup in place of one of the breakers slag (left) of the boilers were removed and repositioned.

For the period of unavailability of the band pickup were kept on the right side of the trousers concasorii spill as a reserve facility where slag is removed canal basin outlet conduits technological pumping station slam.

Leading slag left - right is using a manually operated valves. With the operation sybarite will also consider stopping power or water transport in clay along the canal technology.

Storage platform

Storage platform slag concrete is placed so as to shorten the minimum distance transport of its internal space of the northern side of the stack of bands No.4 coal power plant with coal 7A and 7B. The platform is provided with a water drainage system, which comes from the natural humidity of îmbibaţie discharge of the slag.

Unloading platforms slag recovered from the boiler will be received and woody biomass.

The dosing installation

The dosage of slag and biomass mixture is done, the bands supply coal boilers, a bunker equipped with panty spill, located above the lanes 7A and 7B.

Feeding silage will be using a system of conveyor belts located on one side of the platform.

From the hopper, the mixture of the slag and the biomass is dispensed, alternately, on the belts 7A and 7B, by means of a cellular dispenser and a trouser funnel equipped with a check valve for selecting the tape.

Tests and trials

Originally proposed alternative fuel mixture is 50% clay and 50% woody biomass, but this may change depending on the calorific value. In the course of 2016 in the absence of biomass it proved that clay can be recycled and only mixed with lignite. Consisted only downside so far is that it may report a reduction in CO_2 emissions through the application of technology.

Take periodic samples of slag (slag aggregate sample and a representative of the burning of lignite 20000 t), and analyzed in order to determine calorific value. It analizeza following properties of slag, biomass and mix in different percentages:

- lower calorific value;
- volatile materials;
- ash content;
- humidity;
- coefficient Milling.

Results at project completion

The innovative character of the project is found in two components of the project:

- Execution of parts based on type unique design theme and specifications result of the research activity;
- The definition of alternative fuel and recipe-based dosing nomogram built.

Results obtained to complete the project are:

Slag and prototype extraction equipment for alternative fuel dispensing mechanical installations compatible with existing automated and the ordered local or control room without the need of additional jobs.

Stream description of construction and installation of the prototype plant

Slag recovery plant boilers C5 and C6

Slag recovery plant boilers C6 and C5 providing an slag and loading it in storage bunkers associated temporal. Empty storage bins is performed using two sybarite pneumatically operated with electric drive in cars, trucks carrying Slag Slag dump at the site located nearby the landfill solid fuel (lignite).

Conveyors clay boilers C5 and C6 providing an slag wet after coal combustion in boiler and directing her at the strip scraper, which changes its discharge by adjusting the spill, the bunker takeover transporter designed by the model found boiler 7.

Reception and transfer from tape storage bunker rakes the temporal bandwidth is achieved with R 5/436 CHEVRON type, scraper placed on the active face of the band, each operated by a worm gear motor.

The conveyor slag has the following characteristics:

- Length of conveyor belts: 14200 mm;
- Size race stretch: + 400 mm / -400 mm - 800 mm in total;
- The difference in level (height) to mount the reel: 6000 mm;
- The level difference (stretching): 100 mm / - 100 mm - 200 mm in total;
- Maximum flow rate: 10 t / h;
- material conveyed (transported): wet Slag with a density> 2.6 kg / dm3.

Support is done on conveyor rollers girders and supports. Longeroanele are placed on supports fixed caught the enclosure floor and the pillars of the existing building boilers C5 and C6.

Support brackets are located on the floor of the existing channel side of the slag transport, not to sit on slabs Enterprise / cleaning / closing to be able to ensure the movement of people on the floor in the enclosure, over these channels.

Bunkers intermediate storage were placed at height, with support on the pillars of the existing building, whose lower part is at a height of 3600 mm from the surface pathname of the vehicles by which it will carry clay when necessity requires it (amount temporarily stored). Under these bunkers are placed sibarele download and tapering side walls are assembled by two vibrating role of slag bunker off the landing.

Sibarelor actuation is performed with compressed air coming from existing plants.

Vibrators detaching from the walls metalicii slag during unloading are located side by bunkers and help loosen slag vertical sidewalls and the trunk of the pyramid and its flow in the hopper means for automobiles.

Slag means unloading of automobiles are made regularly at intervals determined by the shift foreman chief depending on operating conditions and inacaracre of boilers.

Each plant has its own automation system

The plant fuel metering

The plant was located at an angle of 10 ° versus perpendicular to the route of the two bands 7A and 7B, an adaptation that allows the operation, maintenance and not affecting existing facilities, with convenient access to the area's vehicles and other means of lifting operating interventions. This installation is designed to achieve clay mixture + biomass fuel dosage on one of the two conveyors bunkers that provide power to fuel boilers and has to recover the remaining carbon in the slag resulting from the combustion of lignite.

The fuel filler consisting of clay and biomass yield in the required proportion concrete platform and loaded into the hopper of the plant with a high capacity loader.

The dispenser is composed of bunker fuel hopper, screw conveyors extractor and conveyor belt inclined.

The funnel supply tapered with large base at the top is a construction made of sheet reinforced with profiles on the outside, with the bottom placed 4 doses gravimetric measurement in the four corners at the bottom are stacked two screw conveyors, rotating in the opposite direction to normal operation. Between bunker and augers no mechanical connection to avoid vibration influence on the functioning of screws doses gravimetric measurement of bunker.

Above hopper on three sides of support were provided metal beams profile HEA 100 to prevent accidental hitting of the bunker and deregulation dose measurement and apron, rubber, not allowing the mixture to penetrate into the cells measuring . Lateral support the construction of a hopper is provided with bracing to ensure stability. On the left, in the direction of transport, under the bin is operated and construction group head of the tape drive dispensers. Over this drive head are stacked augers mix tape discharging dosing.

Estractorului were placed above the three-operated valves that allow a first rough adjustment of the flow of the funnel in alternative fuel extractor.

The extractor is controlled variable speed and spin in opposite directions inwards to ensure an even layer of fuel (mix) tape dosage. The augers are functionally independent and it is possible to break back and forth rotation / detachment concentrations of fibers that can block supply but also independent of each in that sense that is intended as needed. Actuation of screws is done with worm gear motors.

Inclined belt conveyor with gravimetric ensure a flow of biomass fuel mix clay with proportional flow carried by bands 7a and 7b. Flow control, electromechanical dispenser as a whole acts on the speed of the conveyer belt, and the flow given augers extraction of this fuel storage hopper.

Conveyor belt is placed on a construction of profiles that provide the location of the tape at an angle of 18 ° to the horizontal.

Metal construction of conveyor is enclosed with corrugated side walls and roof of sandwich thermal insulation placed on metal frames and bolted tapping profiled pipe structure. The side walls are provided with windows and is included an internal-lighting lighting of ensuring the continuous day / night.

Belt conveyor has a rigid construction and comprises drive head and route features that support brackets roller upper and lower, and at the top head discharge contains screws and mechanism of strip tensile elements are placed in the hopper discharge . Under bunker spill are switching flap in half-life funnel placed in a housing and below it is the bunker of "trousers" which provides one of the discharge conveyors 7A or 7B. The assembly of the bin discharge funnel of the hopper half-life and is supported by a supporting frame which rests on concrete ties of the belt conveyors 7A and 7B

The conveyor belt has the following characteristics:

- conveyor length: 18,500 mm;
- Size race stretch: +500 mm / -500 mm - 1000 mm in total;
- The difference in level of axes of drums: 6000 mm;
- The difference in level, stretching 100 mm / - 100 mm-200 mm in total

Skeleton conveyor consists of:

• Support the entire length abenzi longitudinal profile UNP
• Foot support;
• longitudinal Longeron in UNP 100 3 tonsoane;
• The supports higher bandwidth;

Loading the tape is controlled by the scales from the strip by the electronic metering system, comparing weighing on one of the conveyors 7A or 7B of the coal with the belt weighing dosing. Conveyer belt dosing is separate, unrelated mechanical augers in order to eliminate the error tare dynamics.

Leading fuel metering belt spill in 7A or 7B is provided by a hopper (funnel) clamshell.

Alternative fuel distributor lanes of coal consists of:

• The skeleton of support which rests on concrete sleepers of conveyors 7A and 7B and support: head of discharge (housing and device stretching) hopper with flap control and operating mechanism of its bunker trough trouser closure the bridge and the maintenance. Stiffeners height of the skeleton supporting the girls side are only possible because of existing bands, 7A and 7B, contravintuire not allow the direct perpendicular to the axis thereof.
• Roof with landings which is a closed structure with access bridge conveyor belt and aims at closing the discharge head and bunkers from the upper end of the band. The lower it is at elevation + 4400 mm from the contact surface of the carriers 7A and 7B. It is equipped with walkways around bunkers and a platform for positioning the throttle actuator. The side walls are corrugated sheet with two windows. Interior lighting is provided to ensure continuous interior lighting.
• discharge hopper trousers (and tensioner) is a closed construction conveyor belt caught skeleton and support. The lower frame rests on its support through hopper with flap. It has the following parts: upper housing, lower housing, tensioner belt, tensioner with bolsters translation and bolts stretch that moves the drum spill - stretching to stretch or relaxation conveyor, and centering longitudinal to diversion it.
• Bunker flap that comprises a box shaped structure that is routing and switching flap jet of material to one of two lanes downstream. Manholes are provided for interventions and sealing systems side.
• Bunkers (trough) spill trouser is tilted and twisted spatial construction for directing the band brought material dosage and who discharged one of the bands 7A and 7B
• Group steering damper actuators composed of cilidro-worm gear motor and drive mechanism

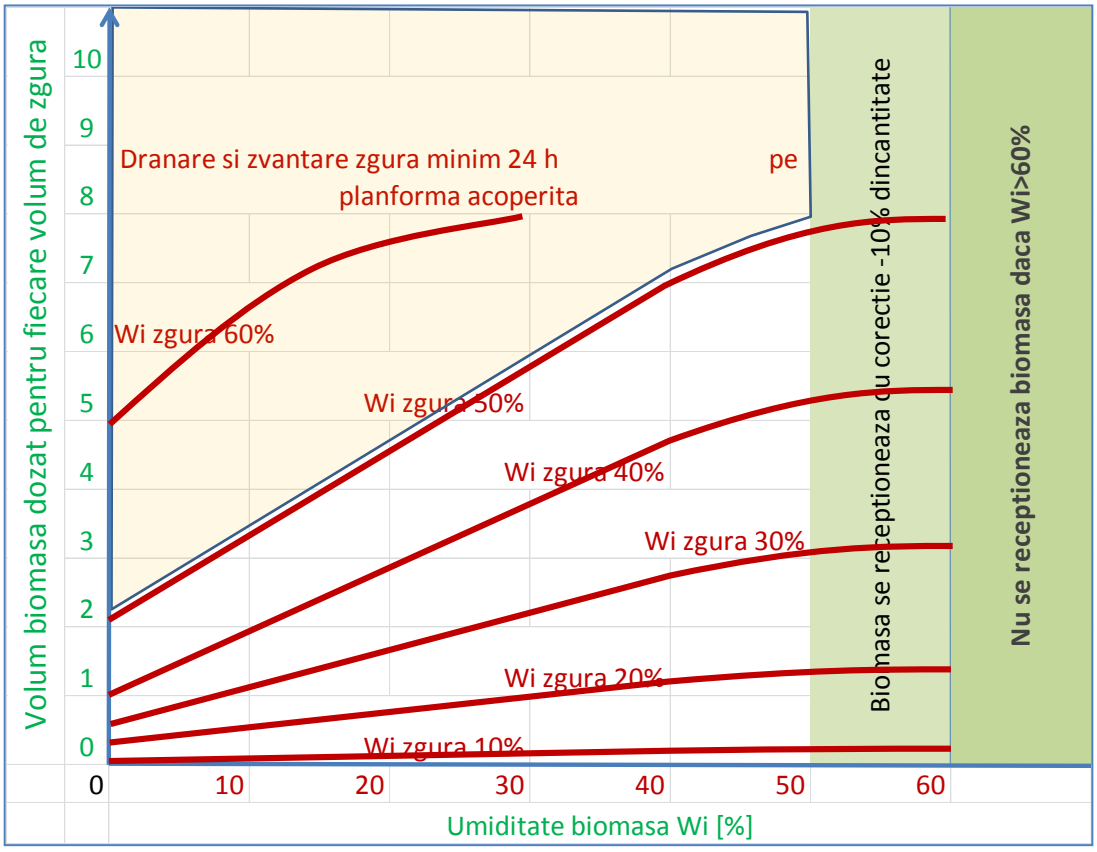
A. Definition and implementation of a clay-based alternative combsutibil.

String processes are assimilated best available techniques under certain conditions. In our case coarsa amount should not exceed 10% of a main fuel. It is also necessary that the new fuel alterantiv proposed to be developed under the project have similar properties. In our case it was opted for biomass clay mixture to improve two parameters: moisture and volatile matter content. The result of measurements made as necessary an interval of at least 24 hours between when drawing boiler slag and the final dosage time bands lignite power plant. Offsetting the volatile matter is sufficiently covered by a percentage of 40-50% by weight biomass. Since volumetric

dosing is done in the following dosing presents curves clay / biomass on three scenarios: Interval 0-24 h; Range 24 to 48 hours; Interval> 48 h.

In the graphs below shows the values dosing clay / biomass fuel filler, depending on the time of leakage of slag, thus reducing the imbibatie humidity from 60% to 30% range 0 - 48+ hours, both sequentially and general.

The graph Overall fuel metering filler (Slag + biomass) depending on the moisture level of each component in the time slot 0 - 48+



As shown in the description, metering systems and alternative fuel Slag Extact ensure the functionality of the project idea as it was defined in the feasibility study.

Cap 2. Operating NOVENER installations in 1st year restriction

2.1. Functional restrictions caused by other ongoing projects in Govora

CHPs Govora is in the process of revamping the large combustion plant for compliance to environmental legislation requirements regarding emissions of SO2, NOx and dust in the atmosphere.

In the first period project monitoring NOVENER respectively in the period November 15, 2015 - April 30, 2016, ended the investments and were carried samples commissioning of two facilities

important Govora in the project funded by SOP - axis 3 "rehabilitation of district heating in the city of Ramnicu Valcea for the period 2009-2028 in order to comply with environmental legislation and increasing energy efficiency" regarding pollution abatement and mitigation of climate change by restructuring and renovating urban heating systems to achieve energy efficiency targets in the most polluted cities.

We describe below the two projects completed during this period C7:

1. DESULPHURISATION FLUE GAS FROM BOILERS NO. 7 CET GOVORA

On 06.05.2016 was issued handover Receiving no. Prerdarea in 7486 on mining investment objective "desulphurisation plant boiler flue gas at No.7 in Govora" CJ concluded between Valcea Govora SA.

To reduce SO2 emissions from coal combustion in the exhaust stream of flue gases from the boiler C7 was fitted wet desulphurization using limestone slurry absorbent substance. The flue gases taken after cyclone enters absorber, where sulfur oxides are detained by direct contact with a limestone slurry (water + powder as limestone). Clean flue gases pass through some demister and are discharged into the atmosphere through a chimney mounted and equipped with a new air emission monitoring.

2. PROJECT IMPLEMENTATION AND REPAIR NOX BURNERS BOILER NO. 7 CET GOVORA

On 07.04.2016 was issued handover Receiving no surrender in 5762 on mining investment objective "Project implementation NOx burners and repair of boiler No.7 CET GOVORA" CJ concluded between Valcea Govora SA.

To reduce NOx emissions within the limits stipulated in the environmental legislation in force objectives and work done in the project for upgrading the boiler 7 are:

- Replace all burners natural gas and coal with low NOx burners;
- Introduction of intake air staging combustion and flue gas recirculation for maintaining a minimum excess air necessary for combustion and reduce temperatrii in the combustion chamber;
- Installing a system urea solution injected into the furnace - secondary measure to reduce emissions of NOx;
- Rehabilitation MVC4 type separators coal mills (6 pieces); increasing fineness of grinding of coal;
- Restoration of air ducts and dampers for gases;
- Temperature control of the outbreak by burning fuels in steps;
- recirculation flow rate of a combustion gas furnace;
- Upgrading boiler plant automation;
- Check the boiler supporting structure for norms for calculating seismic conditions in force and implementing necessary compliance measures.

Emission limit values (ELVs), boiler No.7 achieved through technologies made operating on lignite with 3% support natural gas are:

Combustio	fuel used	legislation	Polluting substance [mg/Nm^3]	O_2

n plant IA 3 (C7)		applied	SO_2	NO_x	PM	CO	(%)
	Mixed fuel (lignite 97% + 3% natural gas)	IED Directive	243,55	197	24,4	245,5	6

2.2. Insloventa procedure triggered SC CET Govora SA

On May 9, 2016 SC CET Govora SA entered into insolvency proceedings such as the development of research development innovation and to attract new sources of grant funding for needle east type of activity has additional restrictions.

In the process of restructuring plan, project director, d it Eng. Ion Avram left and Development Service company within which he worked was disbanded.

They were issued decisions appointing a new management team of the project "innovative conservation technology in coal-fired energy - NOVENER"

- Decision 1327 / 10.31.2016 appointing the project manager NOVENER of Eng. Ion Stoian;
- Decision 1328 / 10.31.2016 appointing NOVENER project management team consists of:

1. Ion Stoian, engineer, Project Manager;
2. Stefanoiu Felicia, economist, Head of Accounting;
3. Udubasa Nicolaie, Information Service;
4. Olivian Mihaileanu, engineer, Head of the Energy sector;
5. Razvan Vatafu, engineer, Head of the Boilers sector;
6. Gheorghe Paraschiv, engineer, Head of the Coal sector;
7. Neciu Daniela, engineer, Head of the Chemical sector.

Cap 3. Operation of energy recovery installations slag

Energy recovery installations slag made in project NOVENER samples regime functioned intermittently during November 2015 - April 2016 restricted as subordinated Force the tests scheduled for commissioning of boiler installations C7.

In December 2015, the consumer was introduced in the entire quantity of Slag accumulated and stored in the stack 4 coal during 2015, conducting only boilers C5 and C6 plants. Not used Slag dispenser equipped with measuring and installation were used household equipment large capacity coal and lignite for forming the mixture of Slag which was used exclusively C5 and C6 boilers.

Of month January 2016 until April 2016 continued intermittently functioning installations recovery and slag samples were performed using equipment and measuring operation of the dispenser Slag.

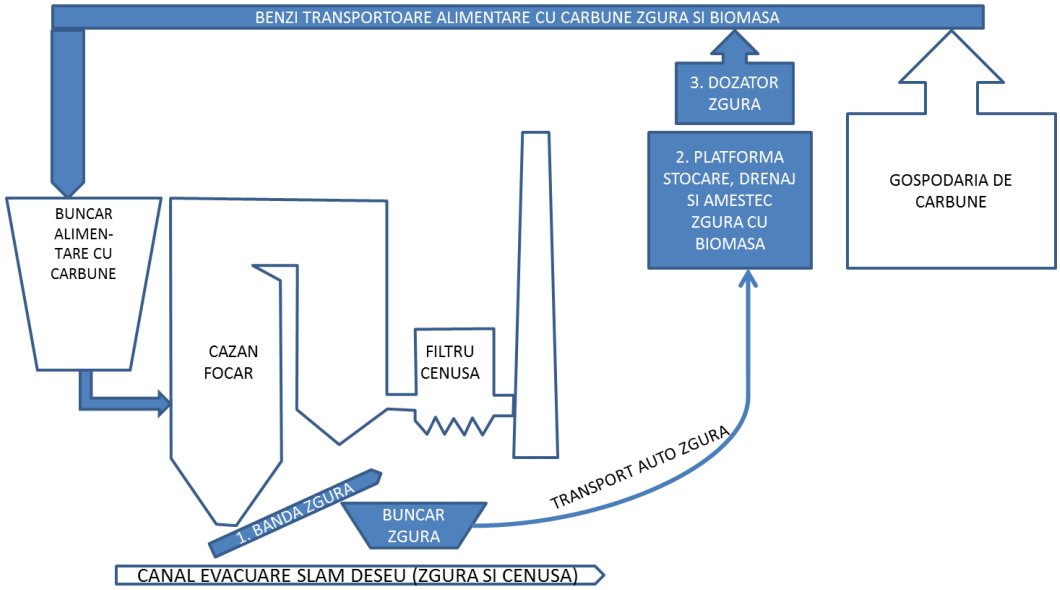
Since May 2016 shall be in normal operation all three parts made in project NOVENER:

- Installation of boiler slag recovery C5
- Installation of boiler slag recovery C6
- Installation of alternative fuel metering bands 7A and 7B

- olso Installation of boiler slag recovery C7.

These together form an innovative energy recovery technology process of mechanically and chemically incomplete nearselor slag discharged from the lignite-fired boilers Govora presented schematically as follows

FIGURA 1. SCHEMA PROCESULUI TEHNOLOGIC DE RECUPERARE ENERGETICA A ZFGURII



3.1. Internal regulation of new technological process created

For safe and effective operation of the installations have been prepared documents for integrated management system environment:

- Was correct operational procedure PO 072-1 "Using lignite mixed with solid alternative fuels at Govora" improved edition is in force since 01.15.2016 and regulating activities to achieve lignite mixtures with other solid fuels Govora to use: coal superior- coal, biomass, wood waste and slag recovered.

- Has been produced internal technical instructions ITI-03-DEZ: "Collection, transport and energy recovery slag" which is in force since 01.07.2016 and which detaliieaza operation of the energy recovery installations made of foam and flow monitoring energy and mass associated with its use.

The aim is explicit instruction process flow and create the necessary record energy recovery process slag from coal boilers of Govora.

Continuous operation of the energy recovery installations slag is defined as the normal operation of power equipment and switching to channel the flow of solid waste Slag suction pumps in emergency regime slam is considering the following aspects

- Increase the energy efficiency of fuel use,
- Avoid clogging canals and pipes slam with clay
- Reduce erosion slurry pumps

- Reduces expenses slag storage in solid waste landfill

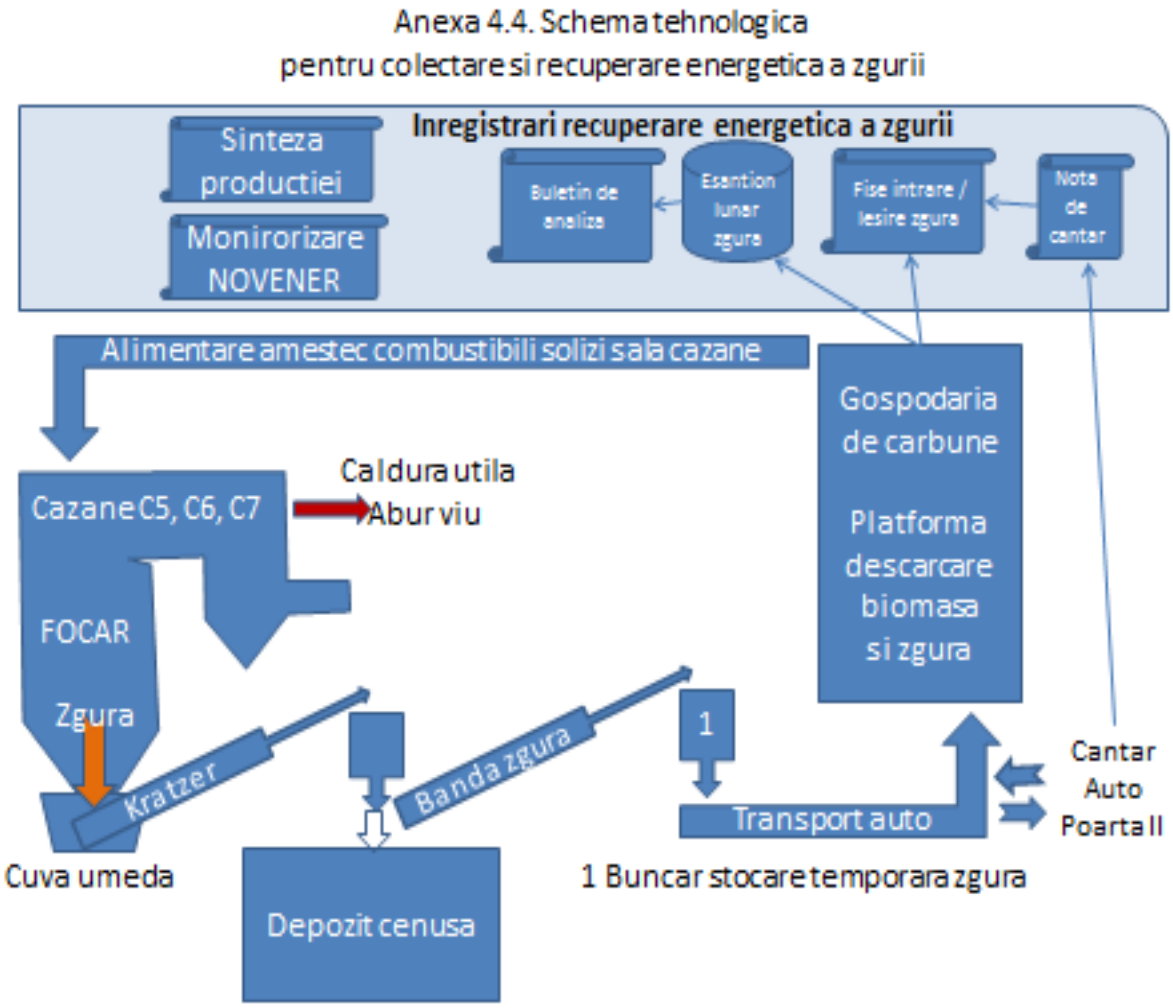
Energy recovery slag creates benefits by reducing the amount of coal consumed proportional but not procedeasa registration to value accounting is given as an internal recirculation of resources.

For the situation in which Slag is for the sale of slag it is estimated price of 55 lei / t. There were no requests for the purchase of Slag in the analyzed period

ITI-03-DEZ instruction defines technological process reuse components slag:

- Clay is continuously recovered from coal-fired boilers are in operation and temporarily store the slag in buncarii 18 cm and fitted each boiler;
- Downloading slag transport means is performed gravitational through local control by the driver; You can use and installation of a vibrating hopper in case you need to unlock the flow of slag;
- Slag transport is performed with a rhythm of transport at least 1 every 2 hours buncarii clay stills up to download platform in the set of shift foreman chief of department Fuel;
- Weighing slag transport is done every car on the scale of the gate 2 and emits note scale;
- In normal mixture min max 3% and 10% coal slag is accomplished bands 7A and 7B alternative fuel dispenser;
- In emergency operation or if the dispenser is used for other purposes mixture of clay and coal can be done with equipment pickup coal serving high capacity tape 1A;
- Record amount of slag is performed by the Department of Fuel and Service Production is transmitted daily; The service will maintain production statistics energy recovery slag as fuel; Supply service by receptionists fuel and chemical sector will achieve a representative sample average monthly slag that will be analyzed at a laboratory accredited for solid fuels.

In technological scheme, part of the instruction, reads and records accompanying the recovery process



On May 9, 2016 SC CET Govora SA entered into insolvency proceedings such as certain expenses were restricted. As a result, in one operating installations made by NOVENER project, Govora not stocked and we did not use biomass for improving the quality of recycled slag. Even so, as a result of monitoring of the technological process energy recovery slag in the 6 months of normal operation of facilities, we find that Slag, drained of moisture imbibatie for at least 12 hours, burning in homogenous mixture with coal and tailings content in fly ash turns, later withheld in electrostatic and does not accumulate on the grill or in the post-combustion wet drum boilers.

3.2. Technical and economic analysis of the process monitored in the period November 2015 - October 2016

Lignite boiler slag recycling is a solution to increase the thermal efficiency of coal boilers and reduce costs for the storage of solid waste-burning. Clay includes in the table remains largely unburned fuel in the boiler due to incomplete or grinding of incomplete combustion.

The content of carbon in Slag measured in the year 2016 is 11.95% minimum, maximum and average 36.28% 22.71% records is. These data confirm the feasibility study extimarile.

Unburned carbon particles of molten slag discharged focuses on funnel furnace and is then cooled stream where water is recovered, is passed on a conveyor belt in particular buncarii build and re-circulated in the flow of solid fuel.

Combustible materials of Slag burn completely to the second cycle of use.

The amount of slag recovered at each boiler in operation period is on average 5 tonnes slag/h/boiler and totaling a quantity of 24300 tonnes in Year 1 monitoring clay. The amount of slag is lower than that estimated in the Feasibility Study (37,000 t / year) due to limitations in the first 6 months of monitoring samples held at boiler commissioning C7. We estimate that in year 2 of operation will recycle a minimum quantity of 45 000 t slag, ie an amount higher than the annual amount estimated in the feasibility study.

Superioada slag calorific value is around 1950 kcal / kg and represents over 90% of the calorific value of coal superioada which comes from burning. Below are the relevant analysis bulletins.

Slag recorded lower calorific power after draining excess water is at least 1268 kcal / kg and a maximum of 1470 kcal / kg and the average is 1373 kcal / kg which represents 81% of the average low calorific value lignite.

This further reduction of net calorific value is due to the excess moisture from the clay can not be removed by drainage

Primary energy recovered and recycled slag controlled operating in one year is 33360 Gcal which equates to an amount of 19 970 t coal thus saved. Energy efficiency of boilers has increased by 1.5% annual averages. Increased yield lower than 3% estimated in the Feasibility Study. The reason is that while collecting a slag represents only 50% of the duration of reporting: Report slag effectively recovered in the course of 6 months to a quantity of coal consumed in 12 months. We estimate that in two operating slag recovery plant will reach the growth target yield estimated in the Feasibility Study 3%.

Reducing carbon dioxide emissions due to the use of slag compared with operation without slag resulted approx. 19 000 tCO2. Provided that this value by dosing of biomass to grow in quantity equal to the amount of slag reused which will replace a larger amount of coal

Slag recovery and transformation of waste into alternative fuel reduces waste (slag and ash) that are stored approx. 41 000 t in the 1st year of reporting. Nedepozitata amount of waste and the costs associated with this activity are higher than the estimates in the Feasibility Study. Combustible material burns entirely of Slag suspended in focus and does not occur in the funnel cloud of cold boiler Slag. This risk estimated in the feasibility study is not confirmed after 6 months of continuous operation facilities.

The recovery process energetic nearselor slag is achieved with minimum transport expenses and investment, can apply to all lower coal boilers in the country but must take into account certain technological restrictions identified:

- Drained Slag is soaked in water in the cooling process; imbibatie water, excess should be drained to avoid being reintroduced into the furnace;

- Combustible mass of Slag content varies depending on the quality of coal burned, the efficiency of milling process of coal and boiler charging regime; Scale is an important content of combustible materials but does not contain sufficient volatiles that contribute to ignition so that the dosage should not exceed 10% Slag mixed with lignite.

The restrictions are defined in the internal procedures of Govora. The technological process answer these restrictions created by these functional components:

- Slag recovery regime is semi-dry in a separate stream, to a temporary storage bunker entering each boiler equipment;

- Clay transported by car and store at least 12 hours on a platform equipped with drainage ditches to drain and draining the imbibatie;

- Periodic laboratory tests are needed to determine continutuluii carbon and moisture from clay;

- Recommend how homogeneous in mixing clay with chopped biomass to create a fuel compatible with lignite; chopped biomass makes a significant contribution volatile in newly created alternative fuel; slag can be recycled without biomass if the clay mixture + lignite is contol.

- Aims to funnel cool the boiler slag in order to avoid excessive accumulation of it.

Application of primary emission reduction of nitrogen oxides, namely the reduction of excess combustion air in the furnace boiler C7 refurbished cause a slight decrease in the amount of slag discharged as a result of grinding finer coal and Growth of calorific slag recovered due to the reduction of combustion air in the combustion grate post.

Below are the laboratory analysis bulletins RENAR for coal and slag recovered from the same coal boiler C7.

C7 is being upgraded boiler combustion in the first stage substoiochiometrica coal burning on the grill such as clay afterburner arrived at the base of the furnace can not burn oxygen in the absence of direct comparison suplimentar.Prin quality fuel boiler slag C7 is better than the one

estimated in the Feasibility study that is found C5 and C6

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CERTIFICAT DE ACREDITARE
LI 062

Raport de analiza nr. 398 din 06.05.2016

Beneficiar (numele si adresa): S.C.CET GOVORA S.A.
Comanda numarul: 178 / 15.03.2016
Obiectul incercat (descriere, stare, identificare): Carbune Cazan 7 / PV1; ORA 13^{00}/03.05.2016; Benzile 1,3,4,6.
Data primirii: 04.05.2016 / Data analizei: 05 – 06.05.2016
Prelevarea probelor: Proba prelevata de beneficiar S.C.CET GOVORA S.A.

Nr. crt.	Denumire incercare	Metoda de incercare utilizata	Identificare proba	Rezultate(1)
1.	Umiditate totala	SR 5264:1995	Carbune Cazan 7 / PV1 ORA 13^{00}/03.05.2016; Benzile 1,3,4,6.	W_t^l: 36,30% ± (2)4.39%
2.	Cenusa	ISO 1171:2010		A^l: 28,22% ± (2)0,85%
				A^{anh}: 44,31% ± (2)1,33%
3.	Carbon	ASTM D 5373-08		C^l: 21,36% ± (2)0,37%
4.	Hidrogen	ASTM D 5373-08		H^l: 2,31% ± (2)0,05%
5.	Azot	ASTM D 5373-08		N^l: 0,56% ± (2)0,02%
				N^a: 0,85% ± (2)0,03%
6.	Sulf	ASTM D 5373-08		S^l: 1,14% ± (2)0,09%
				S^a: 1,75% ± (2)0,14%
7.	Oxigen	Calcul		O^l: 10,10%
8.	Putere calorifica superioara	ISO 1928:2009		Q_s^l: 2129 kcal/kg ± (2) 24kcal/kg
9.	Putere calorifica inferioara	Calcul		Q_i^l: 1796 kcal/kg ± (2) 20kcal/kg
10.	Continut de materii volatile	STAS 5268-90		(3)V^l: 20,44%
11.	Factor de emisie	Calcul		(3)FE: 92,469 kgCO_2/GJ

(1) Rezultatele se refera doar la probele caracterizate in acest raport.
(2) Incertitudinea raportata este calculata folosind un factor de extindere k=2, ce corespunde la un nivel de incredere de 95%.
(3) Incercare neacreditata Renar

Responsabil entitate
Chim. Marius Constantinescu

Responsabil analiza,
Chim. Felicia Bucura

Sfarsit

COD RA-ICSI-A

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Data primirii: 04.05.2016 / Data analizei: 05 – 06.05.2016
Prelevarea probelor: Proba prelevata de beneficiar S.C.CET GOVORA S.A.

Nr. crt.	Denumire incercare	Metoda de incercare utilizata	Identificare proba	Rezultate[1]
1.	Umiditate totala	SR 5264:1995	Zgura Cazan 7 / 03.05.2016;	W_t^l: 55,70% ± [2]6,74%
2.	Cenusa	ISO 1171:2010		A^l: 32,08% ± [2]0,96%
				A^{anh}: 72.39% ± [2]2,17%
3.	Carbon	ASTM D 5373-08		C^l: 10,85% ± [2]0,19%
4.	Hidrogen	ASTM D 5373-08		H^l: 0,25% ± [2]0,01%
5.	Azot	ASTM D 5373-08		N^l: 0,17% ± [2]0,01%
				N^a: 0,37% ± [2]0,01%
6.	Sulf	ASTM D 5373-08		S^l: 0,47% ± [2]0,04%
				S^a: 1,04% ± [2]0,08%
7.	Oxigen	Calcul		O^l: 0,50%
8.	Putere calorifica superioara	ISO 1928:2009		Q_s^a: 1952 kcal/kg ± [2] 22kcal/kg
9.	Putere calorifica inferioara	Calcul		Q_i^a: 1456 kcal/kg ± [2] 16kcal/kg
10.	Continut de materii volatile	STAS 5268-90		V^l: 14,10%
11.	Factor de emisie	Calcul		FE: 114,572 kgCO_2/GJ

(1) Rezultatele se refera doar la probele caracterizate in acest raport
(2) Incertitudinea raportata este calculata folosind un factor de extindere k=2, ce corespunde la un nivel de incredere de 95%

Responsabil entitate,
Chim. Marius Constantinescu

Responsabil analiza,
Chim. Felicia Bucura

Sfarsit

COD RA-ICSI

Cap 4. Patenting innovative technological process

Based on Law no. 64/1991 on patents, republished, amended by Law no. 83/2014 concerning service inventions granting of a patent entitled "Process unit energy recovery of mechanical and chemical nearselor incomplete slag discharged from lignite boilers".

We estimate OSIM patent publication Registry month 2017 January

SOCIETATEA CET GOVORA S.A. Rm. Vâlcea 07-09-2016 NR. INREGISTRAT Nr. 60255

1. CERERE DE BREVET DE INVENTIE Luna Anul

OSIM

Nr.referinta Solicitant/mandatar	Registratura OSIM (numarul si data primirii): A/00603 31-08-2016

Se completeaza de catre OSIM	
Numarul cererii de brevet de inventie	
Data primirii la Registratura Generala a OSIM	
Data de depozit	
Data primirii partii lipsa la Registratura Generala a OSIM	
Data de depozit după primirea părţii lipsă la Registratura Generală a OSIM	
Data primirii cererii de retragere a partii lipsa la Registratura Generala a OSIM	
Data de depozit atribuita cererii de brevet	

1.Solicitanţi (denumire, sediu, telefon, fax, e-mail):
S.C. CET Govora S.A., Ramnicu Valcea, strada Industriilor, nr. 1, cod postal: 240050
Telefon: 0250733601,
Fax: 0250733603,
e-mail: office@cetgovora.ro,
Numar de inregistrare in Registrul Comertului: J38/683/1997

2. Solicitam în baza Legii nr. 64/1991 privind brevetele de invenţie, republicată, modificată prin Legea nr. 83/2014 privind invenţiile de serviciu acordarea unui brevet de invenţie cu titlul: "Proces tehnologic de recuperare energetica a nearselor mecanic si chimic incomplete din zgura evacuata de la cazanele pe lignit"
2.1. Solicitantul este îndreptăţit la depunerea cererii de brevet de invenţie în baza : Legii nr. 64/1991 privind brevetele de invenţie, republicată;
2.2. Referinta la o cerere depusă anterior (numar, data de depozit, tara/oficiul): Nunar: a 2010 01362, din data 17/12/2010, Romania/OSIM

3. Declaram ca inventatorii sunt: cei desemnaţi în formularul „Declaraţie conţinând desemnarea inventatorilor"	
	3.1 aceiaşi cu solicitanţii (nume, prenume si loc de munca la data creării invenţiei)
X	**3.2 Persoanele din "Declaraţia privind desemnarea inventatorilor" care se anexează**

4. Declaram ca inventia contine informatii care au fost clasificate de catre (denumirea, data si nivelul clasificarii):

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4.1. Subject patenting innovative technological process is shown in the patent application as follows:

The present invention consists in creation based industrial experiments, the technological process for recovering the slag discharged into the drum wet at the base of the boilers on lignite secession from the flow of solid waste for disposal and storage to be conditioned in order to reuse as alternative fuel in the flow of solid fuel boilers. The technological process is made up of new or adapted plants and energy boilers in household solid fuel boiler coal and alternative fuel from a recipe created new stringed compatible with lignite.

It is known that in the process classic burning lignite particles coarse coal that can not burn in suspension fall on a grill circulating the bottom of the furnace and continues to burn a limited time after the slag formed falls in the tank below and the outbreak is removed, pumped as slurry, the industrial landfill. Particles of unburned carbon and other combustible materials in molten slag concentrates and cooled water flow based boilers. Such slag includes the fullest extent combustible debris mass of unburnt carbon in the combustion chamber.

Energy recovery technology process slag is a theoretical solution to increase energy efficiency by reducing the consumption of primary energy resources of coal plants but also a solution to increase overall efficiency by reducing costs for disposal of solid waste produced by burning.

Technological solutions are known which prolongs burning barbecues assets until all combustible material is completely burned and flue gases are sucked into the combustion chamber. This technology can be implemented in new boilers, boiler designed and built but requires constructive modifications already made difficult to achieve and very expensive.

And other known processes which together with ash and slag other products from coal combustion are used as building materials, in which case not legally recover energy unburned materials from clay.

The proposed method of energy recovery of nearselor slag is achieved at minimal cost investment and minimum operating costs within the same power can be applied easily to all boilers coal already in operation Store and able to use the ash from burning slag as building material.

The process created new restrictions answer all functional power plants by these functional aspects:

Recovery of slag is booked semi-dry in a separate stream, the newly created being taken before discharge canal inclined to slam on tape and discharged in a bunker temporary storage of at least 1 hour entering each boiler equipment ;

-Zgura Are unloaded from temporary storage bunker in auto transport means and is headed by a concrete platform from household solid fuel boiler fitted with gutters drain water discharge imbibatie slag;

-Stocarea Slag platform drainage is provided for a period of at least 24 hours before being reused;

It's periodic laboratory analysis is needed to determine inferior calorific value of the slag;

-To Create a fuel mixture similar to lignite add chopped biomass that makes a significant contribution volatile in newly created alternative fuel; On the platform creates a homogeneous mixture of clay cit shredded biomass to create an alternative fuel compatible with lignite;

-A Dosing facility consisting dibtr a feed hopper, a conveyor belt equipped with meter and performs a controlled dosage spillway alternative fuel feed stream of coal boilers;

-In Homogeneous mixture with biomass and coal, slag is returned when controlled outbreak, content or mass burn combustible matter and content in fly ash becomes sterile, following the path flue gas flow without causing congestion on evacuation at the base of the boiler.

Dominance of biomass needed to create alternative fuel opertiv are determined using the "Diagram of achieving volumetric mixture of clay and biomass" to ease the procedure of making alternative fuel. The chart is based on laboratory measurements made during 2012-2015 on coal, slag and biomass boiler on experimantele made 7 of Govora and analysis and technical calculations and statistical nature made in the access period.

The diagram is provided to the operator system supply coal boilers.

4.2. Description of invention:

The invention relates to two facilities at a storage platform and a process recovery of useful heat in the form of unburnt combustible material content of slag discharged as waste from biomass power plants.

Specifically technological process newly created consists in recovering the slag before discharge into channels slam slag and ash underlying boilers lignite, separating it from the waste stream to be transported and conditioned for recycling in the feed lignite of boilers,

System formerly known Burning lignite slag is discharged as slurry by industrial landfills along with other coal combustion products.

Clay includes in the table remains largely unburned fuel in the boiler as a result of incomplete combustion or incomplete grinding; so the carbon content is up to 30%.

Unburned carbon particles of molten slag concentrates in which is subsequently cooled water flow based boilers and pumped.

Analyses carried out systematically for three years (2012-2014), the recovery boiler slag coal C7 of Govora reveals a carbon content in the range of 25-35% of the dry weight of the slag.

Boiler slag recycling, in various forms, is a theoretical solution to increase the efficiency of coal plants with waste disposal and reduction of costs are mentioned more advanced processing methods involving its transformation by-products for construction, household uses, etc.

The proposed method of energy recovery of nearselor slag by creating a recycle stream of it into the mainstream of the fuel supply is achieved with minimum costs of transport and investment, can apply to all boilers quality coal but must take into account certain technological restrictions:

Clay is soaked in water discharged in the cooling process; imbibatie water, excess should be drained to avoid being reintroduced into the furnace;

The content of combustible mass of clay varies depending on the quality of coal burned, the efficiency of milling process of coal and boiler charging regime;

Clay has a content of combustible materials but does not contain volatile compounds that contribute to ignition;

Technological processes for recovering the slag should not reduce reliability and operational safety of energy boilers.

The process created new functional answer these restrictions through the following components:

Slag recovery is in semi-dry system in a separate stream, newly created by a temporary storage bunker entering each boiler equipment;

Clay transported by car and store at least 24 hours on a covered platform equipped with drainage gutters to drain and draining the imbibatie;

Periodic laboratory tests are needed to determine the calorific value and lower humidity slag;

It achieves a more homogeneous mixture of clay cit shredded biomass to create a fuel compatible with lignite; chopped biomass makes a significant contribution volatile in newly created alternative fuel;

Controlled dosed such alternative fuel feed stream conducted on the coal boilers;

It aims to funnel cool the slag in boilers to avoid excessive accumulation thereof;

Homogeneously mixed with biomass and coal, slag is entered when controlled outbreak, mass burn combustible matter and content of the tailings turn into fly ash flue gas by following the road without causing congestion on avacuare flow from the base of the boiler

The first stage of the technological innovation introduced is the takeover of slag in the exhaust system hydraulics, the discharge belt scraper at the base of the boiler through a routing system equipped with a flip manual to a funnel unloading by a conveyor belt rubber slag bunker leading to temporary storage boiler slag. In parallel it provides an escape route or emergency reserve slag crusher consists of a slag and a routing channel hydraulic pumps slam. This dual exhaust boiler slag ensure functioning even in case of failure of the conveyor belt slag recovery. Automation systems and signage provided, which indicate the status of malfunctioning tape drive enable timely damper and slag crusher maintaining safe operation of the boiler without the clutter of clay funnel cold.

Sizing conveyor and hopper temporary storage account for average and maximum flows of materials, namely the amount of slag discharged in various regimes of loading the boiler. Conveyor clay is sized to eject the highest flow of clay but will be equipped with speed control system of the tape drive for situations where this flow decreases. Temporary storage bunker slag has a volume dimensioned and is located at a height to allow gravity discharge of slag into the truck at an interval of at least 2 hours.

The second component of the technological process is the storage platform and draining water from clay which has a capacity dimensioned according to the quantities of slag and biomass they need stores and slag to be maintained for at least 24 hours drainage.

If studied platform size is 180 m2 and provides a storage volume of 600 m3, is divided lengthwise into 6 equal parts with free transverse mechanical means loading / unloading which allows working with large capacity equipment in the warehouse and good slag management, biomass or ready to alternative fuel dispensing stream of coal. It is indicated using a front loader with bucket volume of 3 m3.

The first three sections of the platform are intended slag and are alternately in one of the procedures: Loading / Drainage water 24 hours / Download.

The other three compartments store the shredded biomass (sawdust, or other types of recycled biomass) in order relizarii mixture with clay.

The market is available in green and wood waste have already been established recipes for Optimal mixtures of combustible dust with clay are detailed diagrams of alternative fuel and summarily defined as follows:

Green wood chips (moisture content about 50%) are combined in a volumetric ratio of about 50% with clay drainage stored for 24 hours;

Dried wood waste (about 30% moisture) combine in volume ratio of about 33% with clay drainage stored for up to 24 hours.

Coal boilers operate continuously capabilities allow storage of foam provided alternative fuel in discontinuous mode depending on the program supply of coal boilers.

In a stable working regime will not overcome a degree of mixture of up to 10% alternative fuel in coal flow.

The third component of the technological process controlled dosing plant to alternative fuel in the feed coal - dispenser includes:

• feed hopper fitted with Balance and variable speed screw extractor;

• rubber conveyor belt having speed / drive motor speed correlated with the extractor; Balance is equipped with conveyor belt;

• Distribution of alternative fuel coal bands are in walking.

The measurement, automation and control allows dosing dispenser alternative fuel only after pormirea flows of coal, alternative fuels distribution tape loaded with coal and continuous measurement of quantities of fuel transported to buncarii boiler

If studied dispenser has the following specifications:

• Minimum capacity loading hopper = 10 m3;
• weighing capacity = 10 t;
• Maximum Overload> 150% on a corner and> 250% on one side;
• Accuracy of measurement = 2%;
• extractor nominal flow rate = 115 m3 / h;
• extractor minimum flow rate = 15% of nominal flow;
• nominal drive torque = 700 Nm;
• The conveyor belt is equipped with protection against reverse rotation.

The fourth component of the technological process "volumetric dosage charts slag and biomass" created for promptness in making alternative fuel.

The chart is based on laboratory measurements made during 2012-2015 on coal, slag and biomass boiler on experimantele made 7 of Govora and analysis and technical calculations and statistical nature made in the access period.

Operational chart is being made available to the operator / dispatcher bands bunker supply coal boilers

4.3. DEMAND

• Technological process newly created energy recovery slag boilers already in use, lignite by recirculation mixed with biomass in the flow of coal, which process causes a Growth of the energy efficiency of boilers lignite existing in Romania at least 2% ;

• Easy to use facilities based volumetric dosage charts slag and biomass, to establish optimum content to create an alternative fuel compatible burning plant matter lignite

Figura 2.1. Diagrame de dozaj volumetric zgura si biomasa

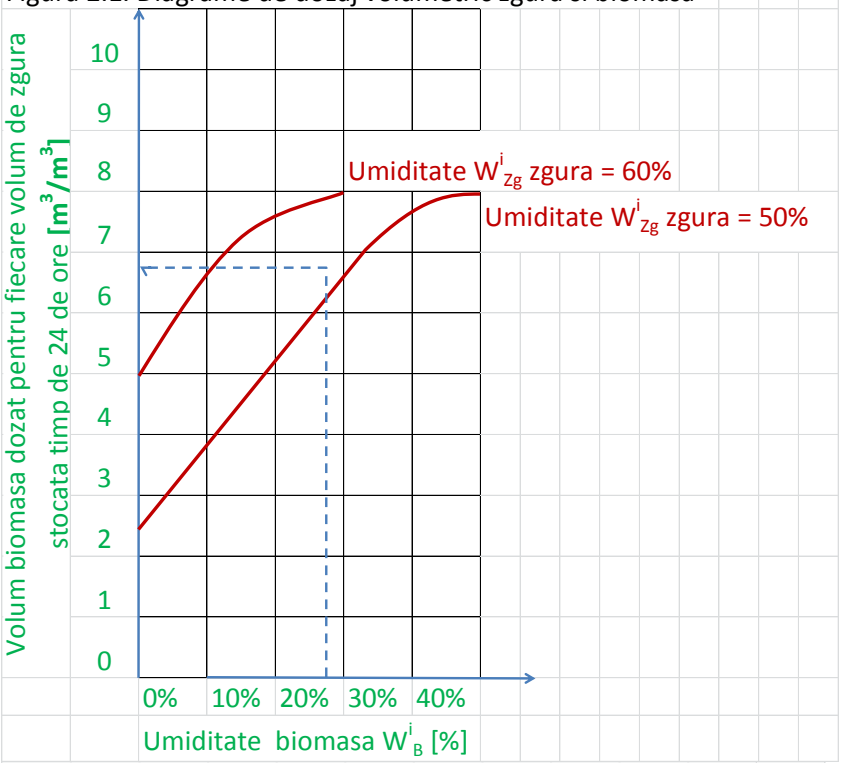


Figura 2.2. Diagrame de dozaj volumetric zgura si biomasa

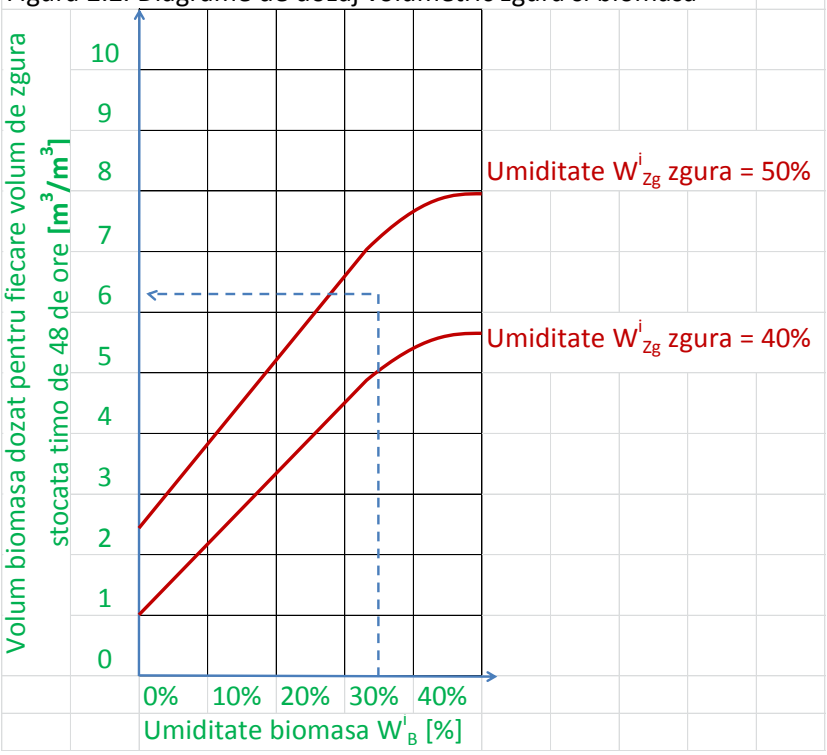
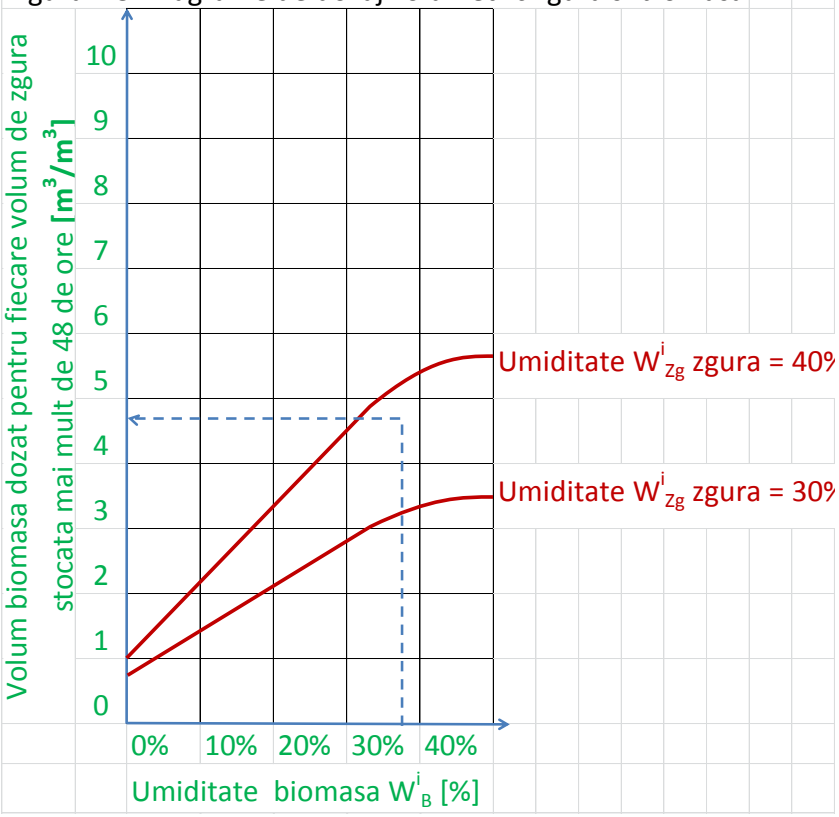


Figura 2.3. Diagrame de dozaj volumetric zgura si biomasa



After the first year of operation of the energy recovery installations slag, slag recycling conclusion is that increases energy efficiency of boilers with coal-lignite 1.5-3% depending on the degree of continuity of the process of recovery of the slag and is all the more necessary boilers retrofitted to control emissions of nitrogen oxides by how, through measures refurbishment is reduced to the minimum flow of combustion air into the furnace so that the slag recovered has higher content of unburned and calorific value higher than that recovered from retechnologized boilers.

As shown in the description, metering systems and alternative fuel clay Extact ensure the functionality of the project's idea as it was defined and the project objectives have been achieved.

Director Directia Generala
Ludovic ZELICI

Director proiect
Ion STOIAN