



S.C. IPA S.A.
Sucursala CIFATT Craiova



Societate comerciala pentru cercetare, proiectare si productie de echipamente si instalatii de automatizare

Str Stefan cel Mare Nr 12, Craiova, cod 200130, Tel / Fax: 0251 418882; 0251 412290; 0251 412775;
e-mail: office@ipacv.ro; web site: <http://www.ipacv.ro>

Sediul Central: Calea Floreasca Nr 169., Cod 014459, Sector 1, Bucuresti, Tel : 021 3161616; Fax : 021 3161620
Inregistrare RC: J40/6202/1991, Cod Fiscal: RO1570298, Forma Juridica: SA, Capital social subscris si varsat: 589.427,4 lei

System for mesurement the quantity of excavated material in open pits; SCADA system for production dispaching

The quantity of excavated material should be known to supervise the coal production and economic efficiency on each excavator. The debit calculating algorithm consist in mathematic formulas having as calculating parameters, the values measured in the technological process and specific technological constants.

The instantaneous quantity displaying in the digging-man's cab allows the supervising of the conveyer loading, elimination of unproductive time, determination of economic efficiency. The system bases on intelligent transducers, control and acquisition equipments.

System description:

The system consist in three units running as an ensemble:

- real time data acquisition equipment- UC-placed into the electric house on the conveyer number two of excavator; into the same electric house there are the current and voltage transducers. The equipment including a local module displaying the quantity of coal excavated and conveyed on the conveyer number two.
- remote data displaying equipment-LCD- which display the data referring to the conveyed quantity of coal (to/h). The equipment is placed into the excavator's cab.
- superior level communicating unit.

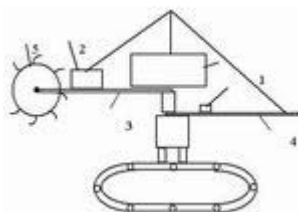


Fig 1. The scheme placing
on the excavator



Fig 2. Local equipment
in electric house;

- 1. Electric house - equipment UC
- 2. Excavator's cab - equipment LCD
- 3. Conveyer number 1
- 4. Conveyer number 2
- 5. Buckets wheel

The equipment consist in data acquisition, processing and transmitting unit:

- supply +12V+5V
- processing board
- analogue data acquisition and converting board
- serial data switching board and watchdog
- board converting RS 232 / RS 232-current loop
- alphanumeric display
- keyboard debit displaying unit
- processing board
- board converting RS 232 / RS 232-current loop
- alphanumeric display
- switch communication processor



Fig3 Displaying equipment into the excavator's cab

All the equipment's modules are dedicated

The module including the voltage and current transducers makes an conversion from high to low that is the ratio of transformation is 100/1, because the acquisition equipment do not tolerate current values higher then 5 A at the current scanning inputs.

The digital equipment calculate the multiplication of voltage effective value, current effective value and the cosine of the phase difference angle between current and voltage.

The current or voltage effective value is calculated by central processor.

In this way calculate the instantaneous power; for data acquisition use a 12 bits fast analogue-numeric converter with a acquisition time satisfactory to solve the problem.

System Functions; Central dispatcher programs

In the mines is needed a quantitative estimation of coal to supervise the production on the each excavator, estimate the costs per product unit and supervise the economic efficiency.

The instantaneous quantity of coal displaying in the excavator's cab allows the supervising of the conveyer loading and elimination of unproductively time to determine the economic efficiency.



Figure 4. Local equipment

For dispatching, it is allowed the monitoring and administration of the following parameters:

- instantaneous quantity (to/h); recording of material quantity (to)
- intensive using indicators
- extensive using indicators
- using indicators of installed power

The equipment has the following functions:

- acquiring the current and voltage data from both motors driving the second conveyer of excavator and conveyer start/stop data ; computing of consumed energy;
- equipment calibration eliminating (basis on an mathematic algorithm) the friction and wear loss;
- estimating the quantity of excavated material (coal or barren gangue); recording in the data bases;
- determination of running and waiting time per periods of time and shifts of workers;
- local displaying of the data and conveyer's state (functional or non-functional);
- data transmitting to the remote data displaying equipment -LCD and to the hierarchical superior level - production dispatcher;
- displaying of the synopsis scheme and general state of excavators and mine;
- data transmitting to the dispatcher (display and printer).

Parameters monitoring, the equipment estimating the excavated quantity of the coal bases on the following reasons:

- the excavated quantity of the coal is proportional with the energy consumed by the motors which drive the conveyer;
- the estimating accuracy is affected by the friction and wear loss of the conveyer, rolls and other elements;
- the loss measuring must be made periodically;

Fig 5. Reports

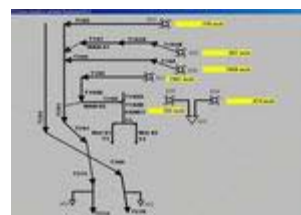


Fig 6. Mine's synopsis scheme

The energetic consumes may be written in this way:

- $E_{\text{process}} = E_{\text{digging}} + E_{\text{moving}} + E_{\text{transporting}} + E_{\text{other mechanisms}}$. The energetic consumes due to other excavator's mechanisms are constant, indifferently of excavated quantity.

The debit computing algorithm:

The algorithm consist in formulas (integral, sums, calculation of minimum and maximum values) having as calculation parameters both the measured values during the technologic process and ECB's specific constants.

The equipment is included in the informatic system and allows a decreasing of energetic consume.

Reports: The user chooses two periods of time - the first is considered as start and the second as stop. After the communication protocol, the soft recasts and prints the excavated quantity of material, the effective running time (conveyer loaded), the using indicator of the excavator's second conveyer. This indicator is calculated as the report between the excavated quantity of material and the effective running time.



Fig 7. Reports

Optional reports:

The user has the possibility to see the data (as table) about a certain excavator: monthly, weekly, daily, shift of workers (it is established by the user the hour when begin a shift and the period of shift).

The user may see the stopping of a excavator between two predefined period of time. The stopping will be shown in a list.

After the communication protocol, the soft provides the following data:

- the quantity / cumulated volume (to/h, or mc/h) between two dates selected by user;
- the total running time within the established period of time (in hours and minutes);
- the unload running time(with unloaded conveyer) within the established period of time (in hours and minutes);
- the total running indicator of excavator(equal with the report between excavated quantity or volume and load running time, within the established period of time).
- The real running indicator (equal with the report between excavated quantity or volume and total running time, within the established period of time; the total running time is a sum between the unload running time and the load running time).

For a on-line analyze the computer displays (with a refresh rate depending on the choused radio system) information about each ECB, as:

- the debit of barren gangue (mc/h);

- the debit of coal (to/h);
- the load running level of excavator (percentage).

For a off-line analyze may be to show the energetic loss on the base of the daily, weekly, monthly, shift of workers, yearly reports.

Analyzing the reports, it is possible to command an efficient and moderate rate of excavation and to prevent an overloading of conveyers leading to an overheating of rubber band and to a negative modification of the price/to report.

Conclusions:

The communication network between the excavator and communication server is a distributed network so, the server questions each equipment included in the system, by radio-link; the excavator answers if it is running and the communication server transmits the equipment's answer (ECB's answer) to a database server providing the data shown above. In Husnicioara mine, each computer endowed with this soft, creates own table copied from server's data base.