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Energy diagnostic at an animal feed production plant

1. Introduction

The diagnostic method described in this datasheet was developed at Tecaliman. Since its introduction in 1987, around sixty energy diagnostics have been carried out at sites with an annual animal feed production rate ranging from 15,000 to 500,000 tons.
The purpose of the energy diagnostic is to:

- establish, characterise and rank the energy performance of each "production unit, production line and/or each significant energy user",
- define improvement directions aimed at guiding the company's "energy" approach.

The diagnostic should have a direct impact on energy saving measures, with each plant having a varying potential for making savings (generally around 5 to 15% of overall site consumption).
The diagnostic is rolled out in 4 steps:

- Step 1: Preliminary study,
- Step 2: Collection of on-site data,
- Step 3: Processing and using the data,
- Step 4: Delivery of the findings.

Depending on the size of the site, an energy diagnostic costs between 45,000 and 70,000 Francs ex. tax (excluding travel costs).
In the second half of 1999, ADEME (the French Environment and Energy Management Agency) will be setting up financial aid programmes to support the performance of energy diagnostics. These grants will cover 50% of a diagnostic's total cost.

2. Preliminary study

This step is designed to identify the features specific to a given site and to prepare the site for the following step, i.e. data collection.

2.1. Review of the plant's overall energy status

The aim is to "assess" the plant's overall potential for making possible energy savings.

The plant status review focuses on:

- specific electrical energy and thermal energy consumption patterns
- cost price of electrical and thermal energies,
- production characteristics.

The plant's energy status is assessed in relation to an industry-wide energy performance dashboard (developed by TECALIMAN).

2.2. Site inspection

A preliminary site inspection is carried out in order to:

- present company managers with an overview that explains the purpose of the study, the roll-out procedure, the information required for successful completion of the study, and the input that will be required from the company in order to carry out the study (in particular, designation of a study leader),
- identify the company's motivations and expectations,
- view the plant's equipment and facilities and start to draw up a list of measurement points (see paragraph 3.2.3.).

2.3. Definition of the work plan

TECALIMAN and the company will have to jointly agree on a date for carrying out the data collection procedure.
One or two months prior to the chosen data collection date (see paragraph 3), TECALIMAN sends the company a work plan, along with preparatory documentation and details on the arrangements to be made for the data collection procedure.
The work plan details how the data will be collected:

- period of on-site intervention,
- installation of measuring instruments for the measurement campaign,
- list of staff who will need to be present during installation of the measuring instruments,

- list of staff to be interviewed and the topics that will be addressed, etc.
- programme for the performance characterisation tests on grinding and pelleting units: roll-out, type of product involved, list of plant staff who will need to be present, arrangements to be made, etc.

Preparatory documentation and details on the arrangements to be made, focuses on:

- description of facility characteristics (manufacturing process, electricity grid, etc.),
- list of production data to be collected during the measurement campaign,
- list of improvements or adjustments that might need to be made to carry out the measurement campaign (e.g. adjustment of the steam network). TECALIMAN will send the company all the necessary technical information on this point.
- data on the plant's overall business activity (see paragraph 3.5).

3. Collection of on-site data

This step is designed to collect all the information required to make a detailed analysis (in the next step) of the plant's energy status.
The data is collected on the basis of a "investigation protocol for a detailed analysis of energy use in an Animal Feed plant" developed and drafted by TECALIMAN.
The investigation protocol covers:

- performance of a measurement campaign,
- technical and functional inspection of the facility,
- characterisation of the performance of grinding and pelleting lines,
- collection of data on the plant's overall business activity.

3.1. Kick-off meeting

The data collection phase starts with a kick-off meeting. This meeting is attended by plant management, the plant employees involved in the data collection process and TECALIMAN staff.
The main purpose of this meeting is to finalise the data collection programme and specify who does what in the data collection process.

3.2. Measurement campaign

3.2.1. Purpose

In theory, the purpose of the measurement campaign is to measure electricity and steam consumption, continuously and over a given period of time (see paragraph 3.2.4), at each production unit, each production line and each significant machine (e.g. a grinding machine).

In addition, one-off measurements may be made in order to identify reactive energy sources, and to quantify the amount of reactive energy they generate.

3.2.2. Restrictions

In practice:

- The options for measuring energy consumption at each of the points described in the Purpose section depend on the legacy structure of the plant's energy distribution networks and the installation constraints on the various sensors,
- the measurement campaign is organised according to the number of measurement points to be taken at the plant and the number of sensors accessible to TECALIMAN

3.2.3. Definition of measurement points

As far as possible, the measurement points will be made on the following items:

Electrical power demand for:
Plant
Reception unit
Grinding unit
Grinding lines
Grinding machines
Grinding machine suction systems
Pelleting lines
Pelleting presses
Precompression processes
Press cooler suction systems
Heat treatment lines
Bulk/Bagged shipping unit
Compressors
Ancillary unit

Steam flow at:
Boiler
Pelleting lines
Heat treatment lines

3.2.4. Inspection period

The inspection period is defined so as to provide the best possible representation of the production tool's standard operating conditions.
As far as possible, the period of the measurement campaign should correspond to the plant's weekly work activity.

3.2.5. Production records

Throughout the period of the measurement campaign, the company sets up all the human and technical means and resources required to obtain the requested production records and forward them to TECALIMAN. Depending on the production unit involved, the requested production records contain

information on:

- product name,
- product characteristics,
- quantity of product produced,
- date and time of manufacture,
- characteristics of the production equipment,
- set-point instructions of the production equipment,

The quality and accuracy of the exploitable findings will depend on these production records.

3.3. Technical and functional inspection of the facility

This inspection covers the following:

- manufacturing process,
- the means used to produce and distribute compressed air (normally, there are no measurements of compressed air flow rates),
- the means used to produce and distribute steam,
- the means used to produce and distribute electricity,

The above-listed points are reviewed via a specific survey questionnaire.
The survey questionnaires cover organisation of the production process (constraints etc.), characteristics (engine power rating, equipment and facility footprint, etc.), cleaning and maintenance (condition, cleaning and maintenance instructions, etc.) and operating procedures for the various machines and equipment.
Each survey questionnaire is supplemented by:

- in-depth site inspections,
- interviews with the relevant employees,
- consultation of the available documentation,
- performance of one-off measurements of various physical quantities,
- performance of various simple tests.

3.4. Characterisation tests on the performance of grinding and pelleting lines

3.4.1. General

The tests are carried out on "benchmark" production products. Representative product samples are taken and analysed.
The tests are carried out according to inspection protocols developed by TECALIMAN.

3.4.2. Characterisation of the quality of the manufactured products

A series of special tests are carried out on the grinding and pelleting lines. These tests are designed to assess the performance of each grinding and pelleting line by introducing a qualitative factor into each manufactured product; particle size for the grinding unit and durability for the pelleting unit.

3.4.3. Characterisation of press mixer operation

"Simplified" tests are carried out on the press mixer. The purpose of these tests is to estimate the mixer's thermal performance by checking:

- temperature and moisture content of the product at press mixer input and output,
- quantity of steam used by the press mixer (vital for carrying out these "simplified" tests),
- fill rate (where possible),
- rotation speed,
- mixer footprint,
- amount of wear and tear on the blades.

These tests are referred to as "simplified" as, to be complete, they would need to include an investigation on the distribution of residence times (tests which are both costly and time-consuming).

3.5. Collection of data on the plant's overall business activity

Among other things, the collected data covers:

- business organisation,
- business production,
- production costs (choice of energies and contracts),
- future outlook,
- specific site constraints,
- energy management,
- regulations governing the site, etc.

This data is collected via a survey questionnaire. This survey questionnaire is mainly supplemented by interviews with the relevant employees and review of the available documentation.

3.6. Wrap-up meeting

The main purpose of this meeting is to review all the work performed during this phase, and to present the forecast schedule for the remaining tasks (e.g. additional information to be provided by the company). This meeting gathers all the people who attended the kick-off meeting.

4. Processing and using the data

This step is designed to make a detailed analysis of the plant's energy status. Processing and using the data makes it possible to:

- spotlight areas for improvement,
- propose an action plan that would improve the situation,
- where possible, assess the potential for making energy savings.

4.1. Energy consumption analysis

This analysis mainly focuses on:

- electrical and thermal energy consumption (kWh/t) specific to each manufacturing unit, manufacturing line, and significant machine,
- energy consumption specific to each batch produced at the grinding and pelleting units,
- distribution of energy consumption between the various manufacturing units, manufacturing lines and significant machines,
- power demand (kW) specific to each manufacturing unit, manufacturing line, and significant machine,
- manufacturing costs (F/t) specific to each manufacturing unit, manufacturing line, and significant machine,
- findings of the characterisation tests on the performance of grinding and pelleting lines,
- quantity of reactive energy generated at the various points that were checked (additional data).

The analysis relates to the measurement points that were made.
The plant's energy consumption is compared against the consumption data in the TECALIMAN database based on all the energy diagnostics carried out in the animal feed sector (see paragraph 1).

4.2. Analysis of facility operating procedures

This analysis mainly focuses on:

- the operating procedures for significant machines (production rate, batch size, batch sequence, idling runs, loading and set-point control, animal meal treatment temperature, etc.),
- Production organisation,
- characteristics, cleaning, maintenance and operation of plant equipment.

4.3. Analysis of the data on the plant's overall business activity

This analysis focuses on the data describing the plant's general business activity, gathered from the data collected on-site.

4.4. Actions that could involve investments

This section species which actions may require major or minor investments or the performance of a specific feasibility study.Delivery of the findings

4.5. Meeting to deliver and discuss the findings

The findings of the analysis and the resulting action proposals are discussed with the company during this meeting (1/2 day).

4.6. Diagnostic report

The diagnostic report presents the following:

- graphs for measurement points taken during the measurement campaign,
- conditions of the on-site inspection,
- findings of the status analysis (taking account of the comments and observations made during the meeting that delivered and discussed the findings),
- action proposals grouped in an energy action programme (taking account of the comments and observations made during the meeting that delivered and discussed the findings),

The study report is sent to the company within fifteen to thirty days of the meeting held to deliver and discuss the results.

5. Bibliography

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