

Challenge for the Engineering Cup

AUTOMATION OF A COAL PREPARATION PLANT

Focus Area

Solutions in the field of digitalization, automation, and improving the efficiency of coal preparation processes.

Objective

To create an engineering–digital solution that increases the efficiency of coal preparation processes, reduces product losses, and minimizes equipment downtime through automation and modern data analysis technologies.

Context and Relevance

Modern coal mining enterprises aim to improve the quality of commercial products, reduce coal losses at all processing stages, and minimize equipment downtime.

However most coal preparation plants are still lacking digital tools capable of:

- automatically analysing raw material composition;
- selecting optimal equipment operating modes;
- preventing operator errors;
- shortening recovery time after emergency or unplanned shutdowns;
- promptly detecting deviations in preparation parameters.

Given rising competitiveness, stricter quality requirements, and the need to improve productivity while lowering operating costs, automation of preparation processes has become a key engineering challenge.

Problem Statement

Due to insufficient automation, coal preparation plants face:

- loss of commercial product;
- instability of preparation parameters;
- delays in operator decision-making;
- increased equipment downtime.

These factors result in economic losses, reduced product quality, and inefficient equipment use.

Challenge for Participants

Propose an innovative digital or hardware–digital solution aimed at increasing the level of automation at a coal preparation plant.

The solution may include (at the team's discretion):

- a system for automatic analysis of incoming raw material composition and control of preparation parameters;
- machine vision or AI algorithms for real-time process monitoring;
- a digital operator assistant providing recommendations on optimal operating modes;
- a system for early diagnostics and prevention of equipment downtime;
- a digital model (digital twin) of selected units or the entire technological circuit.

Participants must describe the operating principles of the proposed system, demonstrate its value to the enterprise, and calculate the expected economic effect of implementation.

Input Data

(Participants may assume an average plant; exact parameters may be modelled.)

- The preparation circuit includes crushing, classification, flotation, separation, and dewatering stages.
- Equipment in operation includes slurry pumps, screens, cyclones, flotation machines, and centrifuges.
- Losses of commercial coal may reach **3–7%**, depending on operating conditions.
- Major downtimes are caused by unstable operating modes, equipment overloads, and human error.

Constraints

- The solution must be technically feasible under actual operating conditions of a working coal preparation plant.
- All proposed technologies must comply with industrial safety standards.
- The system must be integrable with existing equipment or SCADA systems.
- The economic effect must be substantiated with calculations (loss reduction, downtime reduction, increased product output).

Expected Deliverables

1. Concept of a digital complex or engineering digital solution (operating principles, architecture, key functions).
2. Description of automation technology for selected areas of the coal preparation plant.
3. Examples of interface elements, algorithm logic, or technical implementation diagrams.
4. Economic analysis: reduction of coal losses, downtime reduction, productivity growth.
5. Assessment of the solution's scalability to other plants.