Challenge for the Engineering Cup

SAFE OPEN-PIT MINE

Focus Area

Solutions in the field of open-pit mining operations and engineering safety in mineral extraction.

Objective

To develop a functional engineering solution that reduces water inflow into the open-pit mine, improves slope stability, and ensures safe mining operations under complex hydrogeological conditions.

Company Overview

SUEK (Siberian Coal and Energy Company) is one of the largest coal and power producers in Russia.
The company supplies energy to millions of consumers, develops advanced technologies in the mining industry, and places strong emphasis on industrial safety and environmental sustainability.
SUEK actively implements engineering solutions aimed at improving mining efficiency, reducing accident risks, and advancing technologies for dewatering and slope stability enhancement.

Site Overview

The Vostochny Open-Pit Mine is an active coal mining site located in the floodplain of the Ingoda River.
The site is characterised by water-saturated soils, a high groundwater table, and significant water inflow into the mining zone, creating safety risks and challenges for continuous production.

Context and Relevance

Ensuring safe operation of coal open-pit mines under high water saturation is a complex engineering task.
At the Vostochny site, groundwater inflow reaches 3,500 m^3/hour, exceeding the capacity of standard dewatering systems.
The geological formations—sand-gravel mixtures, sandstones, and siltstones—have high filtration capacity, increasing the risk of flooding.
Groundwater level is only 2–3 metres below the surface, which makes typical drainage solutions less effective. This leads to additional costs, equipment downtime, and reduced slope stability.

Modern engineering offers a range of innovative methods for reducing water inflow, including deep drainage wells, geotechnical cut-off screens, wellpoint systems, barrier curtains, and digital hydrogeological modelling.

Problem Statement

High groundwater inflow creates safety risks for workers, increases the likelihood of slope failure, and causes forced production shutdowns.
Existing drainage methods do not ensure stable operating conditions at the mining face.

Task for Participants

Develop an engineering and technological solution aimed at reducing water inflow and ensuring safe mining conditions at the Vostochny open-pit site.

Participants must:
- propose a water control or dewatering technology suitable for the site;
- calculate the economic effect of implementing the proposed solution;
- assess environmental risks and propose mitigation measures;
- prepare an implementation roadmap for 2026 - 2030.

Input Data

- Site: Vostochny Open-Pit Mine
- Water inflow: 3,500 m^3/hour
- Geological formations: sand–gravel mixtures, sandstone, argillite, siltstone
- Water saturation coefficient: 0.75-0.95
- Groundwater level: 2-3 m below surface

Constraints

- Deep open drainage channels cannot be constructed due to the high groundwater table.
- Slope stability must be maintained at all times.
- The solution must be economically feasible and environmentally safe.
- Implementation must not require a complete shutdown of mining operations.

Expected Deliverables

1. Concept of the engineering solution (technology description, diagram, working principle).
2. Economic analysis (reduction in water inflow and dewatering costs).
3. Implementation schedule for 2026-2030.
4. Environmental assessment and a list of environmental protection measures.