

# The Next Phase of Lakeview Mine

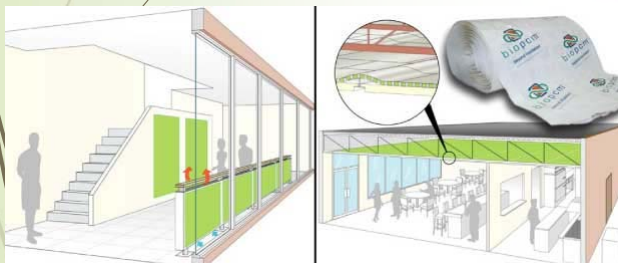
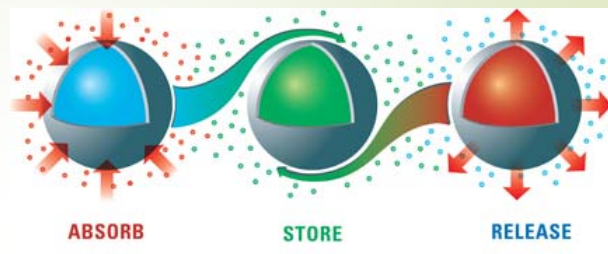
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MDEC 2017

## Phase Change Material (PCM)

- Phase Change Material is thermal management system based on the absorption and release of latent heat



- Phase Change Materials are currently used for various applications including:
  - Regulating temperatures in buildings
  - Temperature controlled transportation
  - Waste heat storage

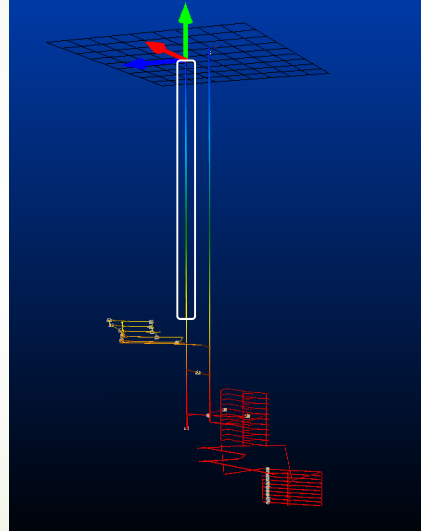
## Lakeview Mine Scenario

### PCM Specifications

- ▶ Wax-based paraffin wax will be applied
- ▶ PCM will be stored in microcapsules
- ▶ PCM will be added to cement mortar at 15% weight

### PCM Application

- ▶ PCM will be applied to the walls of the downcast shaft
- ▶ From surface to 1000 m
- ▶ From 1000 m to 1500 m



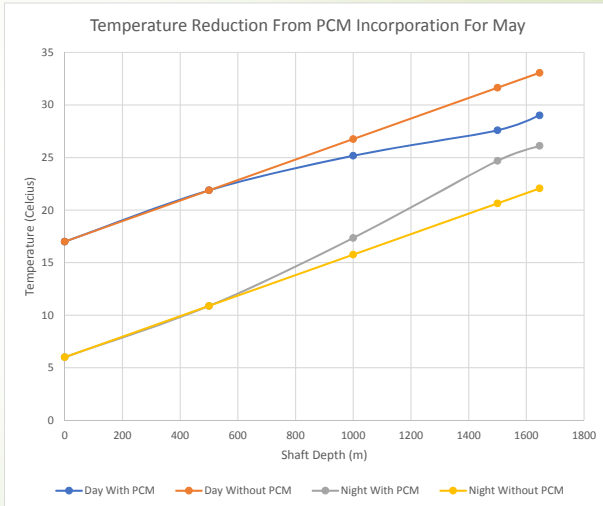
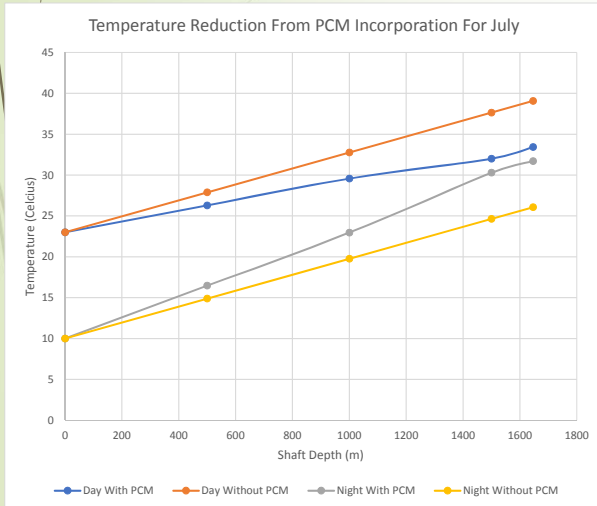
## Types of PCM Used

- ▶ 2 types of PCM will be used in this situation:
  - ▶ A26
  - ▶ A29
- ▶ Both types are manufactured by PCM Products Inc.

PCM Type	Phase Change Temp. (°C)	Density (kg/m <sup>3</sup> )	Latent Heat Capacity (kJ/kg)	Volumetric Heat Capacity (MJ/m <sup>3</sup> )	Specific Heat Capacity (kJ/kgK)	Thermal Conductivity (W/mK)	Max Operating Temp. (°C)
A26	26	790	150	119	2.22	0.21	280
A29	29	810	226	183	2.15	0.180	300



## Air Temperature Fluctuations



## Cost of PCM Application

Cost of PCM Incorporation	
Mass of Mortar	896669.6 kg
Mass of PCM	134500.4 kg
Cost of PCM by Mass	\$7.04/kg
Cost of PCM	\$946,883.05
Cost of Encapsulation	\$426,097.37
<b>Total Cost of PCM for Section</b>	<b>\$1,372,980.42</b>

Table 1: PCM Cost For A26 Section

Cost of PCM Incorporation	
Mass of Mortar	459685.025 kg
Mass of PCM	68952.7538 kg
Cost of PCM by Mass	\$7.04/kg
Cost of PCM	\$485,427.39
Cost of Encapsulation	\$218,442.32
<b>Total Cost of PCM for Section</b>	<b>\$703,869.71</b>

Table 2: PCM Cost For A29 Section

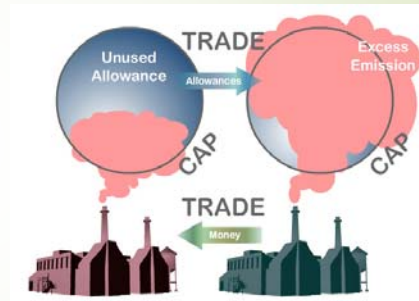
Cost of Mortar Application	
Application Cost by Volume	\$271/m <sup>3</sup>
Mortar Cost for A26 Section	\$2,847,420.38
Mortar Cost for A29 Section	\$1,423,710.19
Total Labour Costs	\$11,229.18
<b>Total Cost for Mortar</b>	<b>\$4,282,359.75</b>

Table 3: Total Mortar Cost

This results in a total cost of \$6.36 million

## Why Choose PCM

- Only 1 application cycle is required
- No operating costs with PCM
- Lack of energy costs with PCM
- Reduce energy costs with the overall system
- Reduce the carbon produced by the mine
- Reduce the amount of required cap and trade allowances
- Presents a greener approach to mining



ANY QUESTIONS?