Modelling Blast Emissions for Open Pit Mining

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Overview of Presentation

- Shift in mentality: Why air emissions became so important for large scale mining projects
- Type of emission sources and why blasting in OP is so essential
- Contaminants generated by blasting
- Emissions estimate: the road to success with no clear direction
- Modelling Input:
  - ✓Surface size and shape of an OP source
  - ✓Base elevation
  - ✓Effective depth and release height
  - ✓Blasting time
  - ✓Meteorological data
- Modelling Results
- Discussion

Mining Projects in Ontario

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Shift in Mentality

- Scale of Open Pit (OP) mining projects in Ontario:
  - ✓Existing OP mines: 900 – 5,000 tpd of ore
  - ✓Projects under approval: up to 60,000 tpd of ore
- EA and ECA phases of a mining project
- Surface rights based on air dispersion modelling
- Public concerns regarding air emissions generated by mining
- Challenges to model and to submit an ECA (Air) application for an OP mining project:
  - ✓ADMGO – OP is mentioned only once in the ISCST3 description
  - ✓Procedure for Preparing an ESDM Report – OP is not mentioned at all

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Type of Emission Sources

- Mine site sources versus Mill site sources
- Fugitive Emissions
  - ✓ Roads
  - ✓ Stock piles
  - ✓ Tailing ponds
- Open Pit
  - ✓ Constantly changing dimensions of this source (L x W x H)
  - ✓ Orientation Angle
  - ✓ OP Effective Area - a hidden player

Contaminants Generated by Blasting

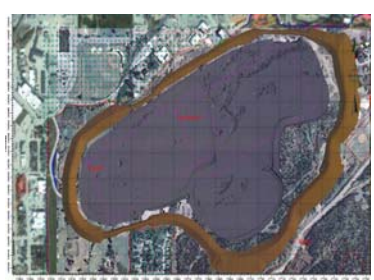
Blast in Open Pit (www.miningaustralia.com.au)

- Bulk Emulsion – Ammonium Nitrate with Fuel Oil (ANFO)
- Carbon Monoxide (CO) – the contaminant produced in biggest quantity
- NO_x – Nitric Oxide (NO) and Nitrogen Dioxide (NO_2)
- SO_x – less emitted contaminant
- PM – TSP and PM_{10}
- Traces of Hydrogen Sulphide, Hydrogen Cyanide and Ammonia

Emissions Estimate

- Amount of explosives used (kg) = amount of ore/rock (tonne) x powder factor (kg/tonne)
- Emission factors: US EPA, AP-42 data for NO_x and CO is about 40 years old:
  - ✓ NOx – 8 kg/tonne
  - ✓ CO – 34 kg/tonne
- Emission factors provided by explosives supplier:
  - ✓ NOx – 3 kg/tonne
  - ✓ CO – 16 kg/tonne
- The approximate ratio of $CO:NO:SO_2:NO_2$ was determined to be 500:27.5:5.5:1 (ACARP data)

Modelling Input



- The size and the shape of an OP:
  - ✓ Irregularly-shaped pit areas should be presented by an equal area of rectangular shape
  - ✓ An open pit could not be subdivided
  - ✓ The size, shape and depth of the pit are changing over the live time of the mine

Modelling Input

- Base elevation – the elevation of the top of the pit
- Effective depth = OP volume (m^3) / OP surface area (m^2)
- Release height – can't exceed the effective depth
  - ✓ No clear recommendations how to set this parameter
  - ✓ Sensitivity modelling runs demonstrate that this modelling parameter is related to an OP shape, orientation angle and a wind rose
- Blasting time – one hour difference is the difference between "pass" and "fail"
  - ✓ Winter and "the rest of the year" – different blasting schedule
- Local meteorological file – is a crucial part of an OP modelling project

Modelling Results and Conclusions

- NO_x 1 hr average – is the most critical contaminant in OP modelling (Ontario case)
- MOE's AAQC lists NO_2 whereas O.Reg. 419 standards apply to NO_x (note both are based on health effects of NO_2)
- NO_2 criteria and NO_x limits are same values
- EA assessment considers only NO_2, however, it is prudent to also evaluate NO_x to ensure site will be compliant with O.Reg. 419
- To determine NO_2 impact from blasting the AERMOD's non-default NO_x to NO_2 OLM conversion method used , resulting for some modelling scenarios in a decreased 1-hour POI concentration by almost 90%
- Sensitivity modelling runs (NO_x 1 hr average) – the only way how to come up with the worst case operational scenario

Modelling Results and Conclusions (cont.)

- Concurrent blasting operations in adjacent pits considerably increase the number of modelling scenarios and the importance of sensitivity analyses
- Modelling results will help to develop the operational/blasting procedures and the BMPP requirements
- The duration of the project can be affected by OP blasting modelling
- The "surface rights" of the project could be established based on OP dispersion modelling
- The modelling guidance documents need to be revised and updated to incorporate OP production operations/blasting

Thank You.

Questions?