

## Orfom® D8 Depressant

*A safer, more efficient reagent for copper/molybdenum separation*

### Product Summary

Orfom® D8 Depressant is a water soluble product useful for selective depression of copper, iron and lead mineral sulfides during the flotation process of molybdenum. This reagent is effective in depressing primary and secondary copper sulfides, iron as pyrite and chalcopyrite, and to a partial extent lead as galena, in primary and by-product molybdenite flotation circuits.

### Highlights

A customer faced daunting obstacles in safe and efficient molybdenum concentrate production through use of the historical depressant reagent sodium hydrosulfide (NaSH).

Struggles included odor complaints from the nearby community and operations personnel, erratic final molybdenum grade and increasing reagent dosages (and associated costs) to achieve target molybdenum quality.

Through commitment to operational excellence and technical support from Chevron Phillips Chemical Company LP (CPChem) Mining Chemicals, Orfom® D8 Depressant provided the needed solution.



### Overview

This case study outlines a successful commercial implementation of Orfom® D8 Depressant as a replacement of sodium hydrosulfide (NaSH) in a copper-molybdenum concentrator



Eliminated odor



Consistent final Mo grade >53%



Reduced reagent consumption 60%



Reduced reagent costs 30%



### A history of success

This operation is one of the world's largest open pit copper mines, and having opened in 1899, is one of the oldest on the North American continent.

The site produces more than 200,000 metric tons of copper per year through two sulfide flotation - concentrator operations, and two on-site solvent extraction-electrowinning plants.

The site operates a secondary molybdenum production facility and has proven to be a leader in commercializing breakthrough technologies. It was one of the first concentrators to adopt sodium hydrosulfide (NaSH) technology for copper-molybdenum separation, the primary reagent used for such operations today, implementing NaSH use almost 50 years ago.

### Looking to the future

While NaSH had provided reasonable mineralogical performance, personnel recognized the need for a more user-friendly and economical reagent for molybdenum production.

The operation faced several difficulties in the use of NaSH including odor emissions that resulted in constant complaints from the surrounding community, exposure risks to personnel, and inconsistent final molybdenum concentrate grade. Furthermore, NaSH consumption had risen so drastically (up to more than 27 Kg/MT) because the site does not utilize inert gas (nitrogen) as well as ore composition changes continually causing the molybdenum concentrate production to be uneconomical.

### Customer Overview

- Operational since 1899
- Employees: >6,000
- Location: North America
- Minerals: Cu/Mo
- Operation: Heap leach, flotation mill and concentrator

### Challenges

- Odor emissions
- Employee exposure risks
- Inconsistent final Mo grade
- Uneconomical costs

A search for an alternative copper-molybdenum separation technology led to interactions with CPChem regarding Orfom® D8 Depressant. Through collaborative investigation, it was determined that Orfom® D8 Depressant could provide the needed performance solution.

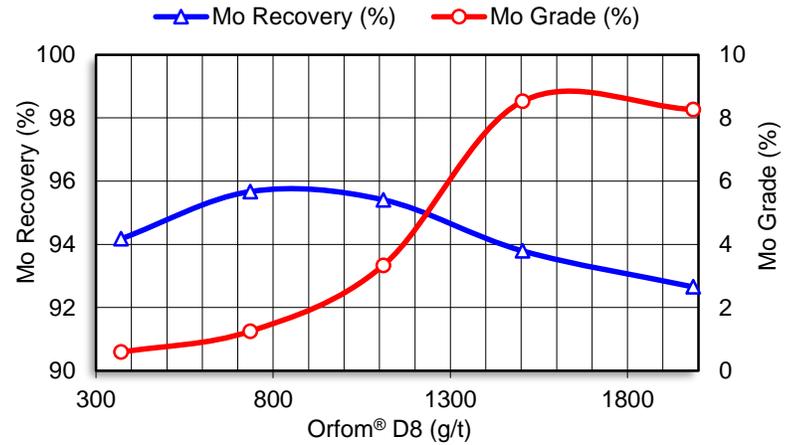
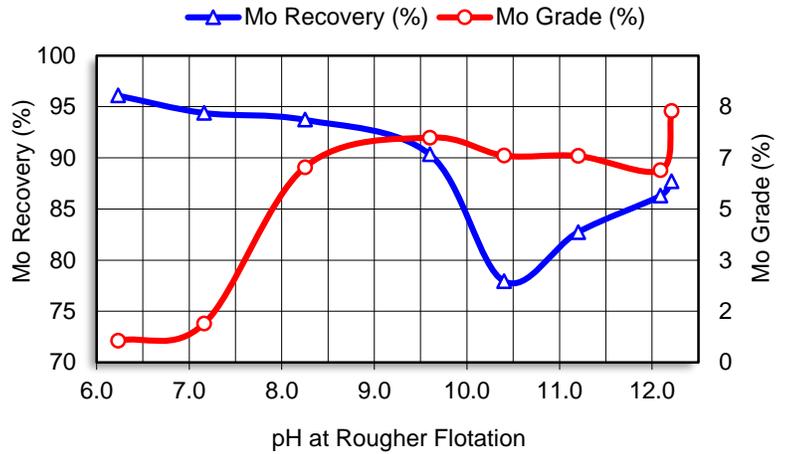


### Implementation

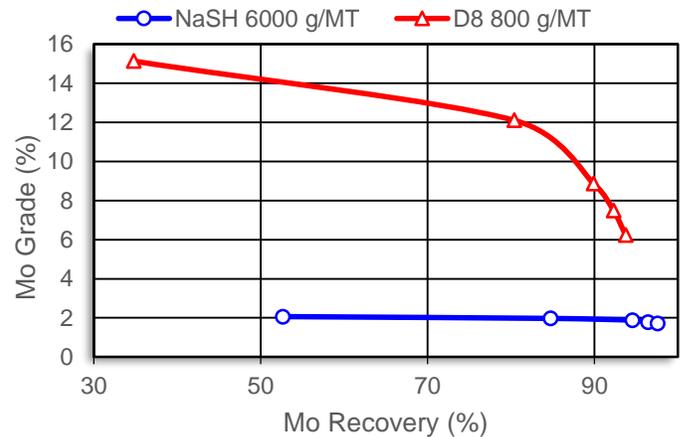
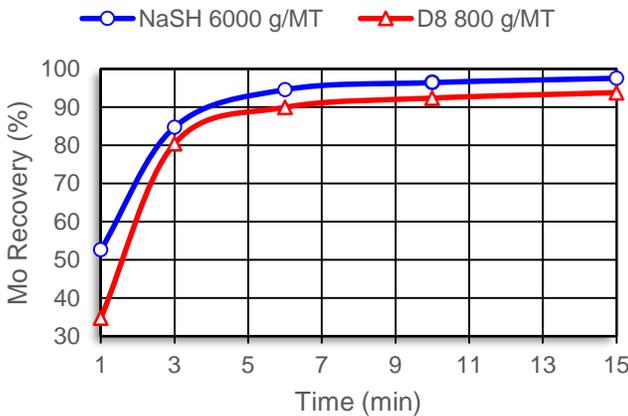
Conversion of the site concentrators to Orfom® D8 Depressant technology started with a close interaction of site personnel and CPChem technical experts in on-site lab experiments.

On-site test data revealed that optimum conditions for Orfom® D8 Depressant use in the rougher stage in plant trial startup were pH of 9.0-9.5, a dosage of approximately 1.2 Kg/MT and conditioning time of approximately 5 minutes.

Lab data confirmed Orfom® D8 Depressant could be utilized in the cleaner stage at a fraction of the dosage used with NaSH partly due to the higher grade Mo grade of the cleaner feed.



“The technical support received from Chevron Phillips was excellent. Both companies worked together as a great team making conversion to the D8 technology successful” – Molybdenum Plant Manager Concentrator 1

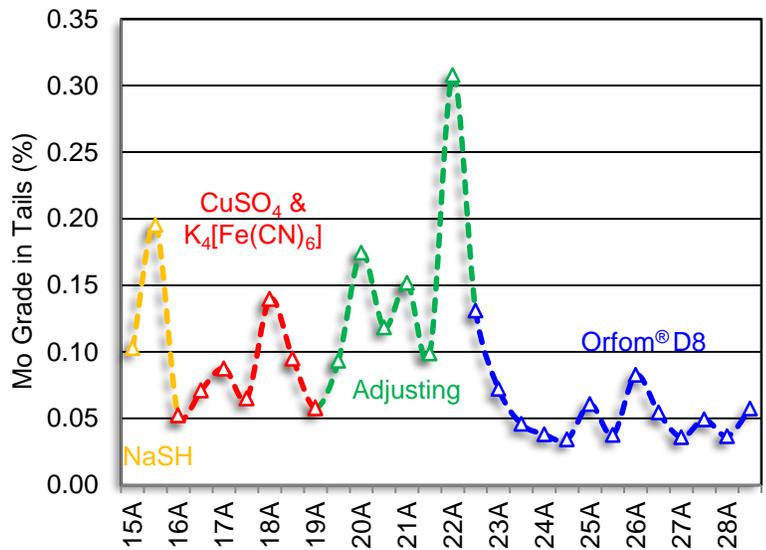
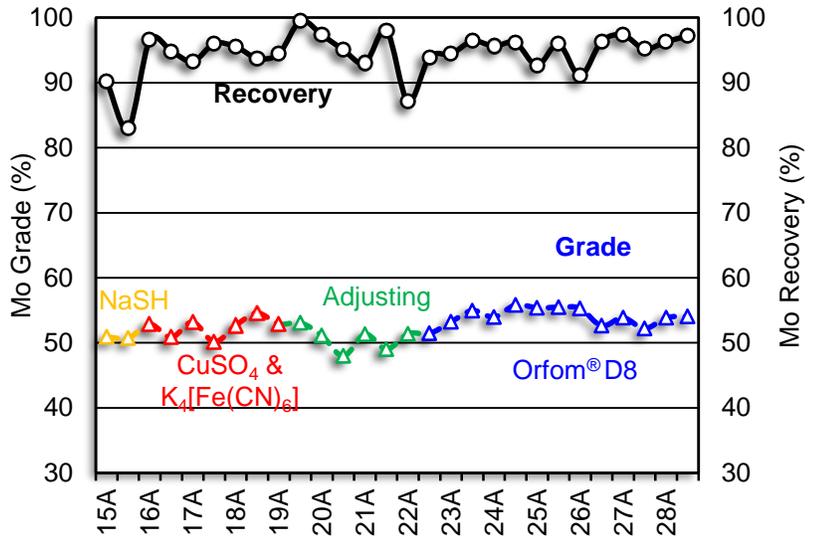


### Benefits on plant conversion

Plant trial and optimization of Orfom® D8 Depressant added to the concentrated rougher circuit occurred over a several week period. After approximately one week molybdenum recovery was improved and final molybdenum concentrate grades were higher (up to 55% final grade) and more consistent.

Plant operators commented that no odors were noticed upon the switch to Orfom® D8 Depressant and no noxious gas emissions were detected by monitors in the process area.

Another criteria of success was how much molybdenum was being lost in the process to plant tailings. Molybdenum grade measurements were made of the tailings throughout the plant trial and found to be significantly lower than before conversion to Orfom® D8 Depressant resulting in more overall molybdenum production and increased income for the operation.

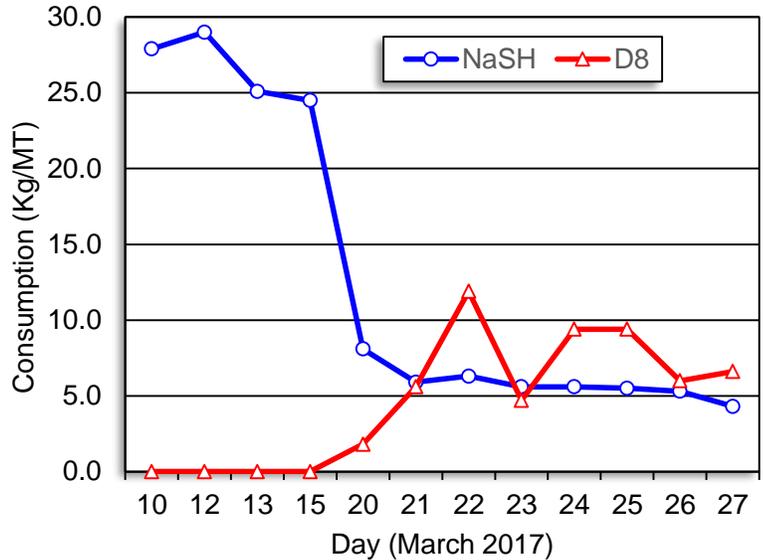


“Plant operators were very pleased that odors from the process were eliminated after switching to D8 and since converting to D8 we have received no odor complaints from the community” – **Chief Metallurgist Concentrator 1**



### Benefits on plant conversion

Upon introduction of Orfom® D8 Depressant, NaSH consumption (dosage) was >25 Kg/MT of copper-molybdenum concentrate feed. Within three weeks NaSH consumption was reduced to <5 Kg/MT and the overall reagent consumption, NaSH plus Orfom® D8, reduced to <11 Kg/MT. While low amounts of NaSH are still being utilized in the cleaner stage, Orfom® D8 Depressant dosage has been further optimized to <1.5 Kg/MT and reducing total reagent costs for the operation by 30%. Conditions are now being optimized for complete NaSH removal in the cleaner circuit.



### Solution summary

Orfom® D8 Depressant achieved all the desired performance targets including lower odor emission from operation, improved hazard profile for operator handling, lower consumption rates and reduced operations costs.

Contact Chevron Phillips Chemical Company LP Mining Chemicals group with any questions and to determine if Orfom® D8 Depressant technology may be a solution for your operation.

Eliminated odor

Consistent final Mo grade >53%

Reduced reagent consumption 60%

Reduced reagent costs 30%



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