Fall 1996

C_3 News

Newsletter of College Chemistry Canada / La Chemie Collégiale au Canada

Hardy Yukon adventurers take to the river as part of the 23rd C_3 conference

C_3 strikes Yukon gold

The recent C_3 conference held in Whitehorse June 6 to 8 was a resounding success. In addition to the usual chemical education theme of the conference, there were several presentations on chemistry of the Canadian north, such as environmental chemistry and the chemistry of gold.

The conference was jointly organized by Louis Schilder (Yukon College) and Bob Browne (Kwantlen College) and included an evening mixer, the annual Fun Run and ended with the popular C3 conference banquet which featured northern delicacies such as muskox and arctic char as well as the musical comedy of Trish Barclay and Friends. The day after the conference, attendees also had the opportunity to either join a train excursion to Skagway or whitewater raft down the mighty Tatshenshini river. Suffice to say, no chemists were lost on either field trip.

All exepctations turn now to next year's conference in Corner Brook, Newfoundland - see page 7 for details.

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C_3 News

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President's message

The conference in Whitehorse was fantastic. I am sure that those of you who were there would definitely agree. From the wine and cheese on Thursday to river rafting and the Skagway trip on Sunday everything went according to plan. The conference program gave us all a good view of the types of chemistry that predominate in the north. It also gave us an insight into the people of the north. Although it may not have focused on chemical education, I am sure that every attendee came away with something new. The only thing missing from this conference was a winner of the C_3 award.

Unfortunately the C_3 Award has not been given out in the last two years. My main goal this year, as president, is to ensure that the C_3 Award does not go unawarded yet again. As an organization of chemists dedicated to education and teaching, we all have colleagues who are deserving of the C_3 award. My challenge to all of you this fall is to look around you and nominate those deserving colleagues.

The complete criteria for the award are available on our web site (http://www.douglas.bc.ca/chem/c3). Here they are in brief:

> The award shall be offered to a person who has made substantial contribution to chemical education, and has been a member in good standing of C_3 for the past five consecutive years. The award consist of a scroll and a cash prize of $600, to assist the award winner to attend the conference where the award is presented. Nominations must be received, in writing, by the Secretary of C_3 by January 1, 1997. Each nomination must be accompanied by three letters of recommendation from peers of the nominee. Nominations will be retained for consideration for three years.

For those of you who were unable to attend this year's conference, start planning and saving now for next year's in Corner Brook, Newfoundland, which should be as fascinating as Whitehorse was. (I can already taste those Atlantic lobsters!)

Suzanne Gardner

Conference highlights

Cost-effective accommodations for students with disabilities in chemistry laboratory courses

John Teggins and Chris Mahaffey, and N. McDaniel, Auburn University at Montgomery, Alabama; and Brian Lendrum, Yukon College

Gary Wilson

John Teggins presented a brief history of projects designed to provide a chemistry laboratory experience to the disabled student. Experiments must meet the pedagogical goals of the course and at the same time take into account the particular disability of the student. Specific challenges include cost and safety factors as well as the amount of extra assistance required. The career goals of the student is an important consideration. To make the experience valid for the student, s/he must be more than a passive participant.

Experiments are made safe without compromising the chemistry principles being taught. All designs are subject to the following question: "What would happen if this entire experiment fell into one's lap?" The response must be "No injury would result", before the experiment is acceptable for use. Auburn's people give attention to designing suitable experiments which avoid high temperatures and corrosive reagents. "Supermarket" items are widely used to minimize cost and waste disposal problems.

Chris Mahaffy described some specific teaching aids. Large typeface lab manuals are provided to students with poor vision. Plastic "glassware", and beakers and graduated cylinders with handles are inexpensive accommodations. Step stools can position equipment at appropriate eye levels and the same result can be achieved for tables using PVC tube leg extensions.

Brian Lendrum, a blind student at Yukon College described some of his experiences in chemistry and biology courses. He began with an object lesson by asking how many teachers had taught blind students. A show of hands made his point. Good communication between the teacher and student will depend on the disability present, and must be taken into account. Each student will be different and the teacher must determine the limitations to communicating with these students.

As a result of the technology that Brian needs, he requires more time to meet course objectives. He uses a Braille typewriter and a Braille computer for taking notes. Since Braille texts are rare he uses audio tapes and computer disks (with a voice output computer). Reading the text and writing exams take more time and this limitation must be taken into account. Given the extent of his disability he was reluctantly required to be a passive observer to many of the experiments.

A prime message to teachers of this paper: Don't make assumptions about what is, or is not possible. Ask questions. Be flexible and innovative. You will learn much.

Outgoing president's message

This was my second and final year as President of C_3 and I am pleased to hand over to the incoming President, Susan Gardner.

Most of the work I undertook was routine, done during the monthly conference call with other executive members. This is very important since the members of the executive were on two opposite sides of the country. The monthly conference calls, usually very short, allow members to discuss issues and events concerning C_3 and use the collective wisdom to take appropriate actions. Similarly, any problems which may arise can be solved relatively quickly. Even though we now have to pay for these conference calls, coordinated through the Open Learning Agency, OLA, they are important and worth more than the money spent on them.

As President of C_3, I have maintained liaison with executive members of other organizations, such as 2YC3 and CSCT. Next year, C_3 will celebrate its 25th anniversary and plans are underway to release a document containing a short history of C_3 at the conference at Sir Wilfred Grenfell College in Corner Brook. Newfoundland, in June 1997. This will be a joint conference with 2YC3. The 1998 conference site, Medicine Hat College, Alberta, is confirmed and 1999 will most likely be in Toronto.

I am pleased to report that the membership in C_3 continues to be high, thanks to the efforts of the Secretary and the Regional Directors. We hope to continue on this course and I am sure, with your hard work, enthusiasm, and commitment, C_3 will have even a brighter future.

Finally, I would like to thank everyone who helped me in making this an enjoyable experience.

Sudhir B. Abyankar

Metallurgy and Mining of Massive Sulfide Deposits

George Hope, Cominco, Vancouver
Heather Avison

This presentation began with an overview of some of Cominco's sulfide mining operations. Their larger open-pit operations extract 20,000 to 275,000 tonnes of ore per day. Interesting notes were that Highland Valley Copper Mine is now the largest man-made hole in the Earth's crust and uses trucks so large that stepladders are required to reach the bumpers; and that Polaris Mine, an underground mine 150 miles south of magnetic north, must use refrigeration to maintain the permafrost and therefore the dryness inside the mine.

Once the ores are extracted, the sulfides must be concentrated for smelthing. the first step is commionution, the crushing and grinding of the mixed ore, which consists of both sulfides and host rock, to produce pieces of optimum size for the flotation process. the next step, selective flotation, is a concentration process only - no chemical changes occur to the minerals. Instead, surface charges are affected. In this technique, floatability is equivalent to hydrophobicity, which requires effectively uncharged surfaces. Most of the minerals of interest have positively charges surfaces, so negatively charges collectors such as xanthates, thiophosphates, dialkyl thiocarbamates, etc. are added. Combined with the positively charge mineral surfaces, this results in effectively uncharged mineral surfaces. the final phase is to add air. The newly created hydrophobes attach to the air bubbles and are floated to the surface in a matter of microseconds.

Limiting factors include particle size (optimum size is between 8 and 100 microns); frequency of locked particles, where the crushed particles still consists of both sulfide and host rock in varying proportions, thereby affecting the particle's hydrophobicity; frequency of entrapment, where the sulfide is totally enclosed in host rock and therefore its surface chemistry cannot be affected; frequency of entrainment, where overly fine particles of host rock are trapped in the air bubble wakes and therefore float to the surface along with the sulfides; and water chemistry, which requires the addition of modifiers, activators and depressants to produce optimum conditions.

Despite all of the analysis, the message of this presentation was that optimization of the method of froth flotation is a balancing act and still something of a black art.

Wetland Treatment of Acid Rock Drainage

Andre Sobolewski and Rob McIntyre
Pat Baird

This poster presentation featured photographs showing a pilot wetland project in its construction and fully vegetated stages. The experimented looked at the zinc and acid levels in mine water before and after being introduced to the wetlands.

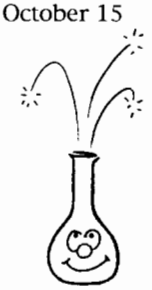
Data from the pilot project from 1995 shoed that zinc concentrations in the water were reduced from 25 mg/L to less than 0.2 mg/L. A natural wetland was documented and found to reduce the zinc levels of mine after from 3.1 mg/L to 0.3 mg/L. Therefore the wetlands removed 90 percent of the zinc..

An important environmental concern is whether wetland plants accumulated metals. A study showed that plants do not accumulate metals even though sediments may contain elevated metal concentrations. Photographs and data documented the capability of a natural wetland to neutralize acid water. Mine water at pH 1.1 had changed to pH 3.3 after flowing through a mossy area, and neutralized to pH 6.6 after flowing through a swampy area.

Upcoming issues

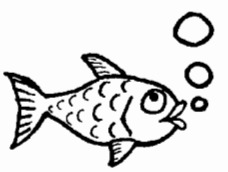
If you have a short news item for Chembits, or would like to submit a short article, please send it to the editor before the deadlines shown below. Handwritten, typewritten, computer disks, fax or email contributions are all welcome. This year's contribution deadlines and issue themes are:

October 15 Chemistry is fun!



January 15 Chemistry and educational technology

April 1 C_3 Conference - Newfoundland



Chemistry on a shoestring: part II; or Plop Plop, Fizz Fizz; Alka-Seltzer in the chemical laboratory

Bob Perkins, Kwantlen University College
Germaine Hwang

The use of Alka-Seltzer tablets in the laboratory is a cost effective method of demonstrating a variety of chemical principles. Students at all levels can safely carry out activities that illustrate the behaviour of gases. More advanced students can measure changes in temperature when a tablet is dissolved in water, or the length of time a tablet takes to dissolve in water at different temperatures, when then allows the instructor to introduce the concepts behind calorimetry and thermochemistry.

The composition of an Alka-Seltzer tablet can be used to set stoichiometry questions, and students can also practice using reference materials to find the physical properties of each component within a tablet.

Alka Seltzer's buffering ability can be investigated by students using some universal indicator, a strong acid, and a strong base.

Winners!

Above: The C_3 Student Scholarship winner, Shannon Bayak (Yukon College), receives her award from C_3 president Sudhir Abhyankar.

Below: The happy winners of the C_3 fun run, Bob Perkins and Rick Bolesta.

Coming to the Yukon

Dave Neufeld, Parks Canada
Jacky McGuire

The lure of the Yukon was not just one of finding a fortune in gold, but it also stirred a revival of the desire for freedom, for rugged open spaces where you had to be strong to survive. In this search for gold and freedom man also brought their culture with them. The First Nations people who already lived there saw the land from a different perspective - it was their homeland. According to their legends, the creation of the centre of the world occurred near Whitehorse. Today both groups of people still have different view of the land.

The rivers of the Yukon played an important role to both groups. To the miners they were the routes for all the freight for years. For the First Nations it was where they could experience the territory - experience the regeneration of life - something that is lost in city life. There are still large areas of the Yukon where there has been no cultural impact. There are not many areas on earth where there are large empty areas where animals may roam free. The collection of scientific data which has started throughout the Yukon is an environmentally-driven undertaking. The traditional lore of the area is survival-driven. The cultural constrains and values of the Yukon must be recognized if the resources of this land are to be effectively managed.

Aqueous Metal Transport and Attenuation in the Keno Hill Mining District

Charlie Roots, GeoScience Office, Whitehorse
Kelly Sveinson

At one time the Keno Hill district of the Yukon was the fourth largest silver producing area in the world, however today most of the mining operations are abandoned. What are the long term environmental effects of such activities? Geologist Charlie Roots described a study of the chemistry of water and sediments in this area.

The two small streams investigated in this study did contain elevated levels of zinc and cadmium, an occurrence which is common when water contacts mine tailings, however the pH of the water is near neutral, which is unusual for acid rock drainage. Charlie explained this phenomenon by considering the geochemistry of the area and some basic chemical principles. In addition to pyrite (FeS_2), the soils of the area contain galena (PbS) and sphalerite (ZnS). Because these minerals are in intimate contact a type of galvanic protection occurs whereby the galena and sphalerite, which have a lower electrode potential, are oxidized preferentially over pyrite, which has a higher electrode potential. Considering the redox equations below explains why the drainage from these tailings is not acidified, in contrast to what happens when pyrite is oxidized:

$$PbS + 2O_2 \rightarrow Pb^{2+} + SO_4^{2-}$$

$$ZnS + 2O_2 \rightarrow Zn^{2+} + SO_4^{2-}$$

$$2FeS_2 + 7.5O_2 + 6H_2O \rightarrow 2Fe(OH)_3 + 4SO_4^{2-} + 8H^+$$

Several other geochemical aspects of the area were discussed in Charlie's interesting presentation. Those interested can read the details of this study in a paper entitled "Lithochemistry and aqueous metal transport in the Keno Hill mining district" published in Current Research 1994-E; Geological Survey of Canada, pp. 7-15.

Cyanide Heap Leaching of Gold

Brad Thrall, Loki Gold Corporation
Rod Restivo

Brad Thrall, the Plant Manager for Loki Gold's Brewer Creek Mine, Yukon, described this process of piling ore material on an impermeable pad, leaching with cyanide and recovering the gold. The advantages of this process on low grade ores (first commercial application in late 1960's) are simple recovery, lower capital requirements, lower operating costs, and shorter start-up periods. The disadvantage are lower metal recovery (78-80%) and recovery difficulties when using complex metallurgical ores.

The process requires oxidized, disseminated ore bodies and fine particles of gold in a porous, permeable host rock, free of fines, clay and carbonaceous material. The recovery steps consist of mining, ore preparation, leaching, adsorption, desorption, refining and detoxification.

In Brewery Creek, the ore is crushed and placed on a permanent expanding pad with a high density polyethylene liner and leak detection pipes (4-inch perforated pipes) over compacted silt (low permeability) sitting on bedrock. A 100 ppm cyanide solution is dripped on the ore bodies from the 1/2-inch polyethylene tubing.

The gold dissolution by cyanide is given by the chemical equation:

$$4Au_{(s)} + 8CN^-_{(aq)} + O_2 + 2H_2O_{(l)} \rightarrow 4[Au(CN)_2]^-_{(aq)} + 4OH^-_{(aq)}$$

High alkalinity or high pH conditions (add lime) must be present.

The adsorption recovery takes place on activated carbon beds produced from coconut shells. For desorption, the material is heated up (>100°C), pressure stripped (85 psi) for 12-14 hours, and electroplated onto steel cathodes (steel wool in baskets). The black gold slug is washed off and filtered in preparation for the refining steps.

An alternative Merrill-Crowe zinc preparation method is given by the chemical equation:

$$2[Au(CN)_2]^-_{(aq)} + Zn_{(s)} \rightarrow 2Au_{(s)} + [Zn(CN)_4]^{2-}_{(aq)}$$ (Zadra et al, 1952).

The detoxification (site specific) for cyanide is done by chemical oxidation:

$$CN^-_{(aq)} + H_2O_{2(aq)} \rightarrow OCN^-_{(aq)} + H_2O_{(l)}$$ and catalyzed by:

$$2[Cu(CN)_3]^{2-}_{(aq)} + 7H_2O_{2(aq)} + 2OH^-_{(aq)} \rightarrow 6OCN^-_{(aq)} + 2Cu(OH)_{2(s)} + 6H_2O_{(l)}$$

The metals Cu, Co, Hg, Zn, Ni, Ag, and As must be removed from the pond by the fourth year of operation. In conclusion, environmental monitoring must be maintained for air quality (dust), ground and surface water and wildlife needs.

Acid Rock Drainage

Dr. Linda Broughton
Stephen L. Hansen

Acid rock drainage is a natural process. Control and cleanup is approached from this point of view. Sulfide deposits are a particular problem, especially pyrite. Pyrite (FeS_2), chalcophyrite ($CuFeS_2$), and sphalerite (ZnS) are a few of the many sulfides which produce acid solutions when oxidized. Acid runoff is also produced directly in the acid leaching of copper ores.

The rate of acid production will depend on the physical characteristics of the heap, e.g. surface area of the ore, or water and air permeability. Sulfide oxidation is an exothermic process, therefore, venting in the presence of water can accelerate the process. However, the kinetics of ARD are not well understood. It is observed that, at first, slow chemical oxidation takes place. As the pH drops the bacteria compete and the rate of oxidation increases.

The prevention and cleanup of ARD is a serious environmental concerns. An extreme corrective measure is to cover the tailings with two or three layers of geosynthetic (plastic) coverings, however, this is quite expensive ($18 US/$m^2$).

Faro Mine, in Canada, has employed another, less costly, method where the tailings were compacted to aid in water runoff and reduce the oxygen content in the heap. Surface lime was added to neutralize any acid produced. This, however, will not affect the internal water. Faro Mines is currently sampling the acid content from various depths in the tailings. This is an expensive study which may provide insight into more effective ARD control.

A mine site in Norway has taken a different approach in the remediation of acid drainage. They placed the tailings underwater to exclude oxygen and severely limit further oxidation. Unfortunately, at first, Zn^{2+} increased and the pH decreased dramatically. It was later discovered that soluble salts were present in the tailings. To remedy this problem $CaCo_3$ was added along with the tailings.

A number of different disciplines and technologies have come together to find ways of reducing ARD. Different approaches have been applied at the various mine sites. Research into this problem is continuing and is far from over.

Chembits

Chris Meintzer from the Northern Alberta Institute of Technology was recently given the Novacor Chemicals Ltd. Award at the 1996 CSC conference held in St. John's, Newfoundland. The award is for outstanding teaching in community and technical colleges in chemistry, biochemistry, chemical engineering technology or chemical technology.

Alan Davis, formerly with the Open Learning Agency in Burnaby, B.C. and also former Editor of C_3 News, has recently joined Athabasca University as Vice President Academic. Despite the increased administrative load, Alan still manages to teach a first-year chemistry course.

24th C_3 Conference: Joint C_3-2YC3

To mark the 25th Anniversary of C_3 and 500th Anniversary of Newfoundland

June 12, 13 and 14, 1997 at Sir Wilfred Grenfell College, Corner Brook, Nfld.

Enjoy the discussion of ideas in Chemical Education as well as a unique rich cultural experience and down-home hospitality - a Newfoundland tradition

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