2004-05 Recipient Essay: SHANE JOURNEAY (shane.journeay@usask.ca)
Milton,NS

Nanotechnology: A new challenge for occupational health and safety

When Dick Martin began his crusade to bring attention to worker health and safety he did so in reaction to “appalling” working conditions (1). Currently the role of the CCOHS is to “provide Canadians with unbiased, relevant information and advice that supports responsible decision-making and promotes safe and healthy working environments” (3). Much of this information is gathered from decades of industrial experience, safety advocates such as Mr. Martin, as well as ongoing research activity. However, how might the CCOHS disseminate information on industrial safety where data on potential risk does not presently exist? As this essay will outline, the impending rapid growth of nanotechnology presents a new challenge for the occupational health and safety (OHS) community, but also gives the CCOHS the opportunity to be proactive safety leaders in an industry that may revolutionize the Canadian work environment. While Mr. Martin worked to improve poor working conditions and employee rights, the CCOHS now has an opportunity to be leaders in protecting the future workforce and shaping safety policy for this new industrial activity. As Dick Martin was a “Canadian pioneer for workplace health and safety”, we now have the opportunity to pioneer health and safety practices in an area that will have far reaching implications in Canadian society. It is through my diverse interests in OHS and my current degree of study that I aim to provide information and awareness which will help ensure responsible growth of this fascinating new industry.

What is nanotechnology?

The advancement of technology in the past decade has allowed scientists to explore the design of materials on a much smaller scale than ever before. This has resulted in a greater focus on the unique interactions and behaviour of nanoscale materials and has subsequently fuelled the field of nanotechnology. Nanotechnology has generated vast interest in the scientific and general community and some have termed it the “nanotechnology revolution”, or the next industrial revolution (7) and even today’s version of the space race (8). Nanotechnology can be defined as “… the manipulation, precision placement, measurement, modeling or manufacture of sub-100 nanometer scale matter…” (10). To put it into context there are 10 million nanometers in a centimeter and 50 nanometers is about one-thousandth the width of a human hair.

Presently, nanotechnology-related activities are abundant in Canada and internationally. Nanomaterials are already used in a wide range of products such as sunscreens, composites, medical devices and chemical catalysts. This field is in its infancy but the quantity of nanomaterials manufactured is expected to increase tremendously in the next five years with a projected ten billion dollar global demand for nanoscale materials, tools and devices by 2010 (9). With such an enormous demand for materials comes a need for workers to mass produce the materials thus presenting a new challenge to the OHS community to develop policies and safety measures to protect against exposures. Concern over industrial exposures and environmental contamination in the USA is reflected in the increased research activity

of the National Institute for Occupational Safety and Health (NIOSH) and the Environmental Protection Agency (EPA) respectively.

Why is it important to occupational health and safety?

Interestingly, the very characteristics of such materials that give them so much industrial potential may also carry the potential burden of toxicity to humans and the environment. In fact, these materials because of their size can access the body and enter tissues in ways larger materials cannot. Additionally, smaller particles show greater reactivity. For example, a gold particle of ten nanometers in diameter shows a dramatic spike in chemical reactivity relative to a much larger gold particle. Recently some of the first published studies have shown that nanomaterials can interact with biological tissues and are more toxic than larger particles. This has spawned a need to study the potential health effects of these materials. However, at present the development of nanomaterials is moving at a greater pace than the OHS and toxicology bodies can evaluate them.

Thus, with the impending boom of the nanomaterial manufacturing industry there is the potential for airborne occupational exposure to these materials with the primary routes of exposure being via inhalation and dermal exposure. The potential effects upon inhalation of nanomaterials are of particular interest to me as I am undertaking my doctoral research in this area. To my knowledge I am the only person currently investigating the toxicology of nanomaterials in Canada. In November of 2004 I was fortunate enough to travel to a symposium in Florida, where approximately sixty scientists primarily from the United States gathered to address the issue of how

to evaluate the potential toxicity of such materials. As one of two people representing Canada, I participated in the birth of a new field of study known as “nanotoxicology”. This reinforced to me the opportunity presented to the OHS community to possibly shape the health of generations of employees to come. As a society we have an obligation to explore the impact of this new industry on employees, the consumers, and the environment that we inhabit. A very similar sentiment was expressed by Dick Martin when he stated “We must become more concerned about unhealthy and unsafe workplaces and the contaminated environment around them…We must remain active and demand change. We owe it to ourselves and future generations” (2).

George Santayana stated “A man’s feet should stay planted in his country but his eyes should survey the world.” It is this statement which reflects both my interest in learning about the international activity in the safety of nanotechnology and my hope that my work will help generate activity and awareness here in Canada. Furthermore, Canada, through leadership from the CCOHS, has the chance to demonstrate proactive OHS with respect to handling of these materials. In keeping with the CCOHS’s mission statement, I believe they can and should be a key facilitator in fostering relationships between OHS research groups and industry to ensure healthy progress of the field.

Learning from history – becoming proactive

There are some interesting parallels between the current attractiveness of nanomaterials and the applications of chrysotile asbestos discovered in the early 20th

century. When first examined asbestos had many desirable qualities such as being relatively lightweight, abundant, cheap to mine and process, resistant to water and acids, durable, and electrically non-conductive (4). Not surprisingly, it came to be viewed, for the first two thirds of the 20th century, as the "indispensable" and even the "magic" mineral (4).

The first paper linking lung disease and asbestos exposure was published in the British Medical Journal in 1924 (6) but it was not until the 1970s that the industry admitted that there was a problem and suitable control measures were widely installed, and backed up with reliable monitoring methods. The world is currently bearing the cost of this lack of action and because of the lag time between exposure and disease the number of cases world wide is expected to continue to rise until between 2010 and 2020 (5).

It is not my intention to imply that all nanomaterials are equal in toxicity to that of asbestos. The fact is there is little data on how nanomaterials may affect human health. It should also be recognized that while nanotechnology may potentially pose a risk, it will bring vast positive changes to society and human health. For example, nanosensors being developed will greatly improve monitoring of human exposures to various chemicals in the workplace. They are also showing enormous potential in the remediation of contaminated environments and in the reduction of pollutants from emissions (8). Additionally, the National Cancer Institute in the USA has stated that “Nanotechnology will change the very foundations of cancer diagnosis and treatment”. Therefore, in light of preliminary evidence that nanomaterials can be toxic, it is important to consider the potential benefits to our society. Given Mr. Martin’s

concern for the industry-environment link and his death from cancer I think he would be excited about such developments, but he would probably have a keen interest in preparing the OHS community for a proactive and vigilant approach to this novel industry. As described by Mae Burrows “Dick was a politician and a strategic thinker who has an incredible knack for finding common ground” (2). It is such qualities I think we should learn from in order to best nurture the cost-benefit relationship of all the nanotechnology stakeholders.

George Santayana also stated “He who does not learn from history is doomed to repeat it”. I am happy to see that some proactive measures are beginning to take shape to ensure we never experience another problem such as asbestosis. Furthermore, history should teach us that we should not revert to working environments that people such as Dick Martin fought so hard to change.

The result of developing a proactive approach to the occupational safety of nanotechnology will be to ensure an optimal balance between the growth of the industry, the benefit to Canadian society and the health of workers and the environment. Dick Martin would likely have advocated such an approach.

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