Winning Back Trace Elements

New Innovations Make the Use of Nano-Sized Materials in Cosmetics a Reality

Downside of Modern Life – The technological development of the past few decades has grown at a considerable pace. Modern society has become saturated with high-tech gadgets, instant microwave-prepared meals, while living healthy has taken a back seat. Lack of sleep, long working hours, stress and irregular meals have become a significant part of today's lifestyle. As a result, it is difficult to maintain an adequate level of trace elements solely through a balanced diet.

Mariya Novak
NanoUnion

The Deficiency of Trace Elements – The Evil of The 21st Century

The problem of trace element deficiency has become a global issue, and looking for the cheapest and yet the most effective way to enrich the formulations with trace elements has become a common practice for R&D departments in the leading fast-moving consumer goods (FMCG) companies.

Element deficiency is an issue that equally applies to disadvantaged populations and industrialized countries, which is why the World Health Organization (WHO) has declared micro-elemental deficiency to be a global problem. In the modern world, more than two billion people suffer from micronutrient deficiencies caused largely by a lack of vitamins and minerals. The solution lies in fortifying medicines, food additives and cosmetics as main providers of trace elements into the human organism.

The Role of Trace Elements in Cosmetics

Since cosmetic and personal care products have become commodities, it is advantageous to use them as a source of trace elements. The deficiency of microelements negatively affects tonus, causes dehydration and reduces the elasticity of cutaneous covering. Sufficient level of microelements favors cell metabolism, generation of collagen and elastin, which affect skin regeneration. Trace elements serve as catalysts of vitamin synthesis and assist in the production of proteins, which are vital for sustaining skin health and, therefore, the whole organism.

The Market of Raw Materials

As a result of market demand, raw material suppliers are bringing out a wide range of trace elements. The presented raw materials can be distinguished by their origin, state and, in their qualities and price, accordingly.

Organic minerals (usually in the form of citrate, rarely lactate, gluconate or acetate) are found in natural foods, making them most familiar to the human body. In contrast, inorganic compounds, such as oxide, sulfate or phosphate are to a high extent alienated by our bodies. Liquid solutions of minerals outperform the powder analogues by the ease of use in various formulations.

Nano: Pros And Cons

Additionally, trace elements vary in their production method. Recent technological developments have shown that metals are inclined to obtain obscure qualities, if taken as small particles, namely nanoparticles.

Metal nanoparticles often possess strong catalytic and absorptive qualities. Solutions containing nanoparticles are quickly immersed with the formulation, which means they have a rapid effect on skin.

When experimenting with nanoparticles, researchers and product engineers encountered a negative phenomenon – it is typical for nanoparticles to create agglomerates, which leads to their uneven spread in the formulation. Some would even argue that nanoparticles are toxic. The effect of metal nanoparticles on human beings, animals and the environment requires further scientific research, and the introduction of active and unpredictable nanoparticles of metals into cosmetics and food should be strictly limited. Nanoparticles can be used in production processes, but they should be entirely eliminated from end-customer goods.

The problem that scientists are pondering is how to preserve the special qualities of nano-sized materials, while creating stabilized non-toxic compounds.

Nanocarboxylates – Breakthrough Innovations in Bionanotechnology

The solution was developed by a group of Ukrainian scientists who in June 2009 patented a state-of-the-art technology for obtaining metal nanoparticles. The innovation was named erosion-explosive nanotechnology.

During the first stage of production, pure metal granules (e.g. silver 99.99 %) are placed into de-ionized water. Electrodes facilitate the electric explosions in the reactor, which results in a drastic change of the metal state, and a vast amount of energy is generated. The energy produced heats the metal and, consequently, causes an explosive dispersion.

Adjusting the frequency of explosions enables the production of nanoparticles of 10 to 50 nanometers in size. The obtained particles are called nanoaquachelates (nanoparticles in aqueous solution). Throughout the second stage of production, a carboxylic acid (e.g. citric acid) is added. The reaction between positively charged ions and citric acid ensures the formation of ultra-pure ecologically clean non-toxic solutions of metal salts. The obtained aqueous solutions of metal nanoparticles were termed "nanocarboxylates."

Due to this cutting-edge technology, nanocarboxylates possess high bioavailability rate and are recommended for use in cosmetic and food formulations. The most suitable solution for cosmetic and personal care goods is offered by nanocarboxylates of citric acid – citrate complexes. Citric acid occurs in the metabolism of virtually all living organisms.

Creating a Balanced Combination of Trace Elements

While the recommended doses of some of the existing trace elements

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are minuscule, their application is essential for reinforcing the bioavailability of other important minerals — for instance, copper, which is mostly used to balance high intake of zinc. Apart from pure single metal compounds, the Ukraine-based research and production company NanoUnion produces customized citrate complexes. For example, SumerSil, which is a mixture of silver and copper citrates, where silver is used as a strong antibacterial agent, while copper accentuates the antibacterial qualities of silver.

The modern consumer is well-informed about market trends, and most shoppers tend to purchase organic yet effective and reasonably priced products. To stay competitive, the manufacturers are searching for highly effective active ingredients with high assimilability rates and affordable prices.

Contakt:
Mariya Novak
NanoUnion, LLC
Kiev, Ukraine
Tel.: +380 44 536 09 76
Fax: +380 44 536 09 75
info@nanounion.com.ua
www.nanounion.com.ua

chemanager-online.com/en/tags/nanotechnology

The Labeling of Nano-Products

Where Cosmetics Lead, Others May Soon Follow

Not-So-Small Problem – The labeling of products to indicate their nanoscale chemical content may or may not be very welcome in the chemicals industry. Already coping with Reach, the last thing the industry would want, it might be said, are the complications and cost of labeling nanotechnology innovations. Then there is always the concern about sending the consumer the wrong message. Still, it may be worthwhile to weigh up the pros and cons before jumping to conclusions on a subject that will surely have to be faced sooner or later, as the cosmetics industry has recently discovered.

Professor Geoffrey Hunt
Director of the Centre for Bioethics and Emerging Technologies, St. Mary's University College

Consumer Nano-products

There are over 1,000 consumer products on the market containing nanomaterials, and very few of these carry specifically "nano" labels, except for promotional purposes. These products range from car wax, plastic products and self-cleaning surfaces to cosmetics, food and drinks, socks and go-faster skis.

It will be said perhaps that consumers are only interested in the effects of an application, not on how the effects are obtained. This was no doubt once largely true, but as an argument it is less and less convincing as the years go by. European buyers in particular are somewhat skeptical of novel technologies, especially if it concerns anything that enters or might enter the human body directly, as in food and cosmetics. In the U.S., Japan and elsewhere the consumer tends to be more pro-technology and arguably less questioning.

It is surely time seriously to consider at least voluntary labeling, and not only from a consumer perspective. Intermediate products, from the raw materials manufacturer down the supply chain, are increasingly using nanomaterials. What is needed is some balanced guidance that is sensitive to the different kinds of need (or no need) for labeling down the supply chain.

Standardization

For four years, I have chaired a standardization project group on drawing up voluntary (not mandatory) guidance on the labeling of manufactured nanoparticles and products containing them. This was first at the national level of the British Standards Institution (BSI) and now continues at the level of a joint initiative at European and International levels: the European Committee for Standardization (CEN) and International Organization for Standardization (ISO).

The BSI's "Guidance on the labeling of manufactured nanoparticles and products containing manufactured nanoparticles" (PAS130), came into effect on Dec. 31, 2007, and was valid for two years. In that guidance the term "nanoparticles" was used broadly to include nanotubes and nanofibers, whereas that term has recently been more narrowly defined as an object with all three dimensions in the nanoscale and the broader term "nano-object" is being introduced more broadly to signify one, two or three dimensions in the nanoscale. This would include tubes and platelets.

The CEN/ISO voluntary guidance on manufactured nano-objects (MNOs) or products containing manufactured nano-objects PCMNOs is now in a complete draft and is under international ballot among the official delegates of national standardization bodies. It went through a long and rigorous negotiation process involving industry, consumer bodies and other stakeholders.

Voluntary Guidance

To avoid misunderstanding, I must emphasize at once that the CEN/ISO guidance is not proposed as a new regulation but as voluntary guidance and would not substitute for any current regulations (the same was true of the BSI guidance.) The point of such guidance is to be helpful to all parties, whether they are neutral about labeling or reactively inclined to be for or against it.

The underlying conviction is that it is best to be open and consensus-building at an early stage on a matter that may otherwise generate divisive controversy that benefits no one and hinders the market. Hopefully, lessons have been learned from the past.

What Is Nano?

With one exception, there are currently no requirements for labeling specifically aimed at the use of MNOs or PCMNOs. Neither is there any regulation specific to the nanoscale properties of nano-objects. There is at a more general level, of course, the requirements imposed by the Global Harmonized System (GHS) for classification and labeling of chemicals, that provides users with information on potential hazards, and this would implicitly include nanomaterials. There are sectoral labeling and safety requirements that may be relevant to nanotechnology

The exception is the EU Cosmetics Regulation of 2009, which does contain an explicit labeling requirement for nanomaterials. I might speculate that the next sector to meet with regulatory labeling in relation to nanotechnology would be food and drink and their packaging. But we shall have to wait and see. I suggest that companies that familiarize themselves with any voluntary guidance from a standardization body would be ahead of the game.

But what is it that we are labeling? It would be a certain class of nano-objects i.e. a material with one, two or three external dimensions in the nanoscale. The nanoscale is the size range from approximately 1 nm to 100 nm, and a PCMNO is product in which MNOs are deliberately added, mixed, attached, embedded or suspended. The guidance therefore does not address nanomaterials that are larger than 100 nm, nor is it concerned with natural (e.g. volcanic) or incidental (e.g. diesel combustion) nanoscale entities.

What's In A Label?

Except to make some generalizations, I cannot go into the details of a document that is currently under ballot, and which may be accepted, amended or rejected. The guidance draft now being considered refers to MNOs and PCMNOs under certain specified conditions.

Clearly, a label which simply stated "this contains nanoparticles" would be meaningless. Among other things the draft guidance is clear on the acceptable use of the term nano in a label. It also keeps in mind what kind of information in a label is useful depending on the particular circumstances and purposes and who the reader of the label is. Minimally, consideration might be given by a relevant party to indicating in a simple fashion that a particular chemical substance in the product is in fact nanoscale in some dimension. Other information such as CA number, size range, surface area, aspect ratio and amount may or may not be relevant, depending again on the circumstances.

Parts of the document function as helpful reminders on what kind of thing specific to nanomaterials the manufacturer and anyone in the supply chain might wish to consider for the purposes of labeling. It adopts a life cycle approach.

Nothing is mandatory, and the changes proposed are simple to implement and have the benefit of enhancing communication and lessening misunderstanding.

An Ethical Issue

There is probably now sufficient, if far from decisive, information from toxicologists concerning some nanomaterials to suggest that labeling would be a sound precautionary measure at this stage. Besides the issue of risk, which the CEN/ISO draft guidance neither deals with nor dwells upon, there is the simpler issue of public perception and the right to know.

Labeling is already perceived as not just an informational issue, but as an ethical one. It would only take one adverse incident, possibly misconstrued or magnified by the media, to result in the public demand: "Why weren't we told nanoparticles were being put into X, Y and Z?" This would damage the entire industry that is using nanotechnology techniques. The acceptance by a company of voluntary labeling for nanomaterials, under the appropriate circumstances, would undoubtedly help the corporate responsibility profile of that company.

Contact:
Professor Geoffrey Hunt
St Mary's University College
Twickenham, UK
Tel.: +44 20 8240 2311 (or 4250)
huntg@smuc.ac.uk
www.smuc.ac.uk/cbet

chemanager-online.com/en/tags/nanotechnology