Case 16

Fire and Flame Control with Citrus?

This article introduces a physico-chemical solution for controlling fire as one of the 100 innovations that shape "The Blue Economy". This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment. For more information please consult www.zeri.org or www.blue economy.de.

by Gunter Pauli

The Market

The world market for fire and flame retardants is estimated at $ 3.7 billion for 2010. The market for halogen-free chemicals that prevent fire are already $ 2.72 billion and growing. The health consciousness consumers in Europe and Japan, and tough legislation around the world are pushing hazardous halogenated products out of the market. However the growth in demand for all fire retardants comes from China, which is expected to expand demand by more than 13 percent over the next 12 months.

The history of flame controlling chemistry dates back to the Egyptians who soaked wood in alum (*hydrated potassium aluminum sulfate*) to prevent it from burning. Demand for fire controlling agents was limited to wood until the introduction of petroleum-based products which forced the use of flame retardants as a safety standard. Insurance companies played a central role in pushing its use. Parliaments passed legislation imposing these chemicals in couches, cars, computers, cables, curtains and many more items. Ironically, the very regulation that was intended to are still dispersed into the environment. Safety objectives were met, however health impact turned out to be an unintended consequence.

Half of the chemicals used to slow down the spreading of the flame and to suppress smoke are laced into plastics found in cars, planes, trains and homes. The remainder is used in textiles, furniture, paper, interior decoration, bedding, lamps, candlesticks and workwear. Mounting research suggests that these fire and flame retardants may cause neurological and reproductive illnesses, a dysfunctional thyroid, and all sorts of cancer. As a result of the evidence provided by scientific research, one of the worst molecules (DECA) will be phased out voluntarily by the market leaders Albemarle, Chemtura and ICL Industries by 2013.

The Innovation[1]

New regulatory guidelines for the reduction of toxic chemicals drives demand for flame retardants that do not bio-accumulate. As governments set new standards for flammability and smoke for a wide range of products, innovators are given a unique chance to enter the market. Experts forecast that nanotechnology will play a key role in improving performance, creating amongst others polymer-clay composites. Mats Nilsson, an inventor with a track record from Sweden, imagined a totally different solution based on food grade chemicals. He names the discovery, which has been patented worldwide, the "Molecular Heat Eaters" (MHE) which is inspired by the way warm blooded animals metabolize food.

The successful development of this flame retardant is based on the theory that energy released during an acid-base reaction, determines the amount of energy needed to degrade the results from an earlier reaction. Sounds like an example of physico-chemistry. Mats designed a reaction between an organic acid and an inorganic base, which generates a strong exothermal reaction. When the temperature rises it creates a barrier for fire on the surface so that heat does not spread and fire does not propagate throughout.

To create fire you need three components: oxygen, heat, and a combustible material. First the MHE bind oxygen to form water using salts, producing positively charged ions (cations). Cations provide carbon to build more char faster, a non-combustible material, generating - in the process - CO2, a non-flammable gas. Thus oxygen is "consumed" and char covers the surface, in an environment of inflammable gases. The raw material needed to manufacture the MHE could come from grape pomace and citrus fruits. The MHE are produced in tiny biodegradable particles, in the form of a liquid, a gel or a powder. The minute size of these salts increases the surface area, this multiplies and thereby speeding up the chemical reactions, leading to a reduction of the amount of fire retardant needed.

The First Cash flow

The main challenge is to optimize the blending of fire retardants into a wide variety of products. A PVC for example, is rich in chlorine, and requires different concentrations of MHE depending on the additives to soften the plastic or to protect it against ultraviolet, which either enhance flammability, or stimulate it. After years of trial and error, a portfolio of competitive product applications emerged: wall-to-wall carpets made from polyamide, pipes and carpet back coating made from PVC, flexible foam made from polyurethane, cellulose for paper, polystyrene for construction and insulation.

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[1] The description of the innovation is a simplified representation. For those interested in a more detailed scientific approach can read the explanation by Mats Nilsson, who wrote in detail how he understood the physico-chemical processes that lead to his discovery.

Mats Nilsson went on to create Trulstech AB, a Swedish company that evolved into Biomimetic Technology Ltd. based in the Leeds (UK). He opted for a series of licensing agreements with companies in the USA and Australia. Its Swedish partner Deflamo AB went on to get listed on the secondary market in Stockholm. Deflamo is preparing full scale manufacturing of the ingredients to respond to industrial demand, and leapfrog from a wholesaler of the core ingredient, to the producer of multi-density fiber board protected with this natural fire and flame retardant.

The Opportunity

The innovation described goes beyond the mere substitution of one chemical with another. It offers opportunities to recycle grape pomace and citrus waste offering new perspectives to wine producing regions, to substitute toxic chemicals with food grade molecules, and to convert a highly centralized industry with few global players into a hub for regional initiatives, supported by a patent portfolio. In addition, the range of applications can quickly evolve from carpets on planes, and casings for computers, to fire extinguishers, and environmental friendly chemistry used in forest fires.

Someday, the same technology could even be applied in the mining industry, where sparks cause explosions and force the use of expensive nickel-based equipment. The most fascinating option in the future is the possible misting of the MHE to incapacitate guns and cannons. While there is no proof of this concept yet, the fact that the product is already competitive in price and performance at the outset of its market introduction, offers an indication of how far this product could go. It is up to the entrepreneurs around the world to complement what is there and get the business rolling.

For further background on the 100 cases: www.blueeconomy.de

VIDEOS

For a video demonstration of how this technology works, please click on:
http://www.youtube.com/watch?v=0875g4GW_Rw&feature=related

For an introduction to the Citric Acid Cycle, please click on:
http://www.wiley.com/legacy/college/boyer/0470003790/animations/tca/tca.htm

Application of the fire and flame retardants. Photos provided by Trulstech AB.

Mats Nilsson, the inventor. Photo courtesy of the inventor.