

Eggs for Personal Care

By Gunter Pauli

This article introduces a creative approach to egg shells 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.

The Calcium Carbonate Market

The global calcium carbonate (CaCO_3) market has passed the magic 100 million tons mark and is expected to continue to grow to a \$35 billion industry by 2015. Growth of consumption in the Asian market is expected in excess of 7 percent between now and 2017. China produces approximately 70 percent of the world's output. Calcium carbonate is an inorganic mineral used as a filler in paper, plastics, coatings as well as talc and kaolin for personal care. The paper industry represents the largest market since mineral generates brightness that is in high demand without the need of adding chlorine which has recently been eliminated due to its adverse effect on health and environment. Wood free uncoated paper which accounts for nearly 40 percent of the total paper market is the largest end user of calcium carbonate-based fillers.

Calcium carbonate is non-toxic and at a certain purity level, it can be used as a direct food additive or an ingredient for cosmetics and even pharmaceuticals. Its use in writing tools has decreased with the advent of chemicals-based pencils. Pearls, shells, fishbones and corals are important depositories of this highly alkaline mineral that has potentially a growing demand were it not constrained by mining. Calcium carbonate was first produced commercially in 1841 in the United Kingdom by treating calcium chloride with soda ash. For the past century calcium carbonate is extracted from lime stone. Today the largest producer in the world is Specialty Minerals Inc. (SMI), a subsidiary of Minerals Technologies Manufacturing (USA) producing over 4 million tons of calcium carbonate each year in 55 factories located in 18 countries good for nearly \$600 million in sales. The largest producer in India is Kunal Calcium limited, a company that increased output fivefold over the past decade demonstrating a strong increase in consumption throughout Asia.

The Innovation

The main raw material for calcium carbonate is mined limestone. Most limestone is skeletal fragments of marine organisms especially corals. The extraction and processing is usually done onsite. Limestone was a popular building material in the Middle Ages, however due to its reactivity with acids, historic buildings have been damaged severely by acid rain and lost favor in this climate where acid water and air dominate the urban environment. Pure calcium carbonate as an additive for food or medicine is made from marble, and cosmetics occasionally include ground pearls. Dissolved calcium carbonate is found in abundance in

water, leading to water hardness, scaling pipes and causing damage, especially in water boilers. The chemical process to soften water is based on sodium or phosphates. This renders the calcium carbonate useless for any commercial application, worse the use of phosphates turns water unsuitable for drinking. Unfortunately none of the waste water treatments can remove calcium carbonate effectively as a by-product, thus its presence costs more in maintenance, and shortens the life of equipment.

Brendon Risby has been fascinated with the vortex technology that was first described by Viktor Schauberger about one century ago. Brendon and his father had pioneered many designs and exchanged early on drawings with Curt Hallberg who successfully went on to develop vortex-based applications for conditioning water through the company Watreco AB (see Case 1). Unlike Curt, Brendon studied possible uses of the vortex to separate materials and one of his first commercial applications was the processing of organic waste. He studied how to grind, dry and separate waste into high value products. He focuses on local processing of waste using this swirling movement that follows a precise mathematical algorithm. He could quickly identify multiple business opportunities for his innovative use of the vortex concept design. He went on to create a machine that treats a wide range of feeds, from peat and sludge to sand drying and clay processing, and even specific waste streams such as used carpet tile recycling. This vortex-based apparatus was later branded as the "Vortair Processor". In 2009 Brendon went on to create with partners AgroPlas A/S, a Norwegian-British company focusing on transforming the research insights into intellectual property and build-to-operate business models. Actually, AgroPlas is dedicated to transform the negative cost of waste into valuable and sustainable products that generate revenue.

The First Cash Flow

One of the first waste streams Brendon focused on was eggshells, considered a cost at hatcheries and food processing factories. In Europe alone, there are an estimated 150,000 Tons (T) of eggshells sent each year to landfills at a cost of €50-200 per ton depending on the location. Over half a million tons of eggshells are discarded in China. Since eggshells are a well-known source of pharmaceutical grade calcium carbonate, the key is to separate the membranes from the shell. This originally tedious and costly process is highly simplified by the Vortair machine, transforming this waste into a valuable source of renewable calcium carbonate free of membranes without the need for any moving part or human hand. One Vortair unit can process 10,000 T of egg waste at an anticipated cost of €6/T, offering a revenue that is a multiple. The high quality calcium carbonate processed without the use of any chemicals and with minimal energy offers a potential revenue of €1,300/T. This breakthrough is likely to create a major shift in the high end calcium carbonate market, evolving from a cost of millions of shredded marble to a revenue potential of hundreds of millions. The Vortair is the only known technology capable of efficient and profitable upcycling of eggshells. The conversion of a waste into a renewable raw material improving the competitiveness of the industry while reducing the need for mining, is one of the priorities of The Blue Economy.

The Opportunity

Whereas this technology has been commercially pioneered in 2011, it is expected that only the local processing of eggshells could lead to the creation of 30 to 50 new companies, all operating locally a Vortair in connection with a major industrial complex. The same principle could be applied to paper sludge, which due to its content of clay is landfilled as waste. The Vortair separates first water and subsequently produces two dried substances, one with organic fibers and the other with non-organic clay. Both qualify for commercial reuse and sales. With a capacity to process the waste slurry from paper recycling at the rate of 25,000 T/y, this innovation not only permits the reduction of the load on landfills, it once again increases the revenue potential without needing any recourse to the drying or pressing at high energy cost. Europe's paper recycling plants dispose of an estimated 20 million tons of paper sludge each year. This implies that this innovation has the potential to lead to 800 processing plants that could be established within the European Union alone, reducing the load on landfills generating income. Entrepreneurs where are you?

It is no surprise that the potential to reduce landfill, and increase revenue has motivated some municipal companies to take the lead and pioneer. The first municipal company in the world that decided to invest in these innovations presented by Brendon and his team is the City of Drammen in Norway. Since 2001 the citizens decided to reclaim as much resources as possible from waste and they created Lindum A/S to reduce landfill use, reduce greenhouse gas emissions, reduce the consumption of raw materials, reduce energy consumption and increase the revenues for the town. The company has been earning about one million Euros in net profit annually. Bolstered by their first decade of success, Lindum is now partnering with AgroPlas demonstrating the potential to convert waste management into a material supply chain that renders the community more competitive, generating jobs and steering business towards sustainability. Who said there are only entrepreneurs in the private sector?

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