

# Advances in Medical uses for Alumino - Silicate Clay Minerals, focusing on Naturally Occurring Kaolin, Smectite and Halloysite

## Kaolin and Montmorrillonite

Kaolin has long been associated with medicinal qualities, in particular the internal use of kaolin and morphine for diarrhea and stomach upsets and the external use of kaolin preparations, as facemasks or poultices, to improve skin condition and reduce swellings. There are three long established grades of kaolin approved to British Pharmacopoeia: BP Light, BP Light Natural and BP Heavy.

Kaolin and morphine works by absorbing toxins from the gut and bulking faeces. Facemasks absorb oil, dirt and toxins from pores in the skin and poultices provide localized heat and moisture to relieve pain and draw pus.



For the last 20 years or so Goonvean Ltd, now part of Imerys, has supplied the bulk of the global BP kaolin market, estimated at 1500 tonnes per annum. Prices range from £600 to £1200 p.m.t., depending on the grade.

Montmorrillonite has been used for its detoxifying affects for many years. It can be taken either internally as an aqueous preparation or applied externally as a cream, taking advantage of the bodies ability to excrete heavy metals through the pores of the skin. A number of commercial products are available with 'Great Plains' very popular in the US.

In many cases medical benefits from kaolin and smectite occur due to their absorptive power in removing unwanted matter such as heavy metals, pollutants and fungi. In such cases more highly refined clays with finer particle size and greater surface area are likely to be more effective. However, in the case of bacteria and virus elimination the reverse seems to be true, in that unrefined clays that contain specific trace metals are better.

Kaolinite and smectite both have a layer lattice structure. Smectites are much finer and have the ability to swell significantly and to absorb water.

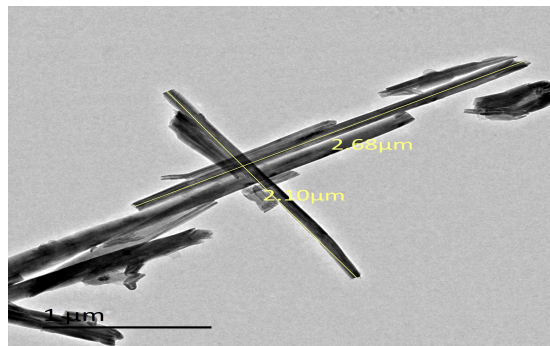
A brief summary is shown below covering some new ideas and research:

1. Relief of **mouth sores** caused by radiation treatments. Kaolin particles form a protective barrier.

2. Relief of **gastric and peptic ulcers**. A protective barrier is formed.
3. Montmorillonite, usually mixed with Psyllium fibres, can relieve the symptoms associated with **Irritable Bowel Syndrome** by absorbing toxins
4. Ca Montmorillonite can be taken internally to **remove traces of mercury** following removal of dental amalgam fillings.
4. Infused bandages and gauze for improved **control of heavy bleeding**. In addition to absorbing blood, kaolin activates the blood clotting system.
5. Aflatoxin is a highly **carcinogenic mycotoxin** produced by aspergillus fungus, which can be found in cereal crops, particularly in hot & wet countries. The negative charge on the platy surface of kaolin combines with a positive charge on aflatoxin, such that > 90% can be removed. This is achieved by pre-dosing food preparations with approx. 1% kaolin and is mainly used for animal feed (don't forget that we eat the animals!) but also for human food e.g. in parts of Africa.
6. A combined research program by universities and hospitals in Pakistan using local kaolin has shown promising results for inhibiting **Hepatitis C Virus**. Work will continue to discover the mechanisms involved.
7. Research at the University of Arizona has demonstrated positive affects from kaolinitic clays in killing the **MRSA and other viruses and bacteria such as E Coli**. The mechanism is related to the release of specific metal ions such as Cu, Co, Ni and Zn from the surface of the clay particles.

## Halloysite

Halloysite is chemically very similar to kaolinite but the alumino-silicate sheets are rolled into tubes. Major deposits occur at Matauri Bay in New Zealand, owned by Imerys and at the Dragon Mine in Utah, owned by Applied Minerals. I - Minerals is currently developing a new deposit near Bovill in northern Idaho, which is characterized by a high aspect ratio (longer tube length).

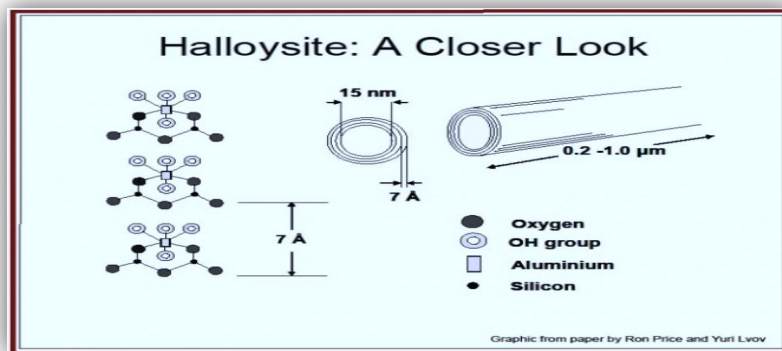


TEM of Halloysite, Bovill, Idaho  
(Courtesy I - Minerals Inc.)

Halloysite Nanotubes (HNT) have been the subject of intense investigation in recent years due to their ability to hold and slowly release pharmaceutical preparations at a uniform and sustained rate with no initial surges (overdose).

Halloysite tubes can be enlarged internally to increase volume capacity, by etching the lumen with suitable acids. Active pharmaceutical preparations are loaded into the hollow tubes by vacuum techniques. Release rate can be tailored from hours to days by 'capping' the ends of the tubes, which is achieved by reacting the internal chemical agents with metal ions or using starch. An alternative procedure is to encapsulate the HNT with polymers such as polyethyleneimine.

Most research to date has been done with halloysite from the Dragon mine supplied via Sigma Aldrich to research institutes.



Re-printed by courtesy of Prof. Yuri M Lvov, Louisiana University

HNT competes against synthetic engineered carbon nanotubes but is approximately 100 x cheaper at \$3/lb. v \$300/lb. Additionally, there are concerns that carbon nanotubes may have adverse health affects whereas halloysite is non-toxic.

A review (by no means exhaustive) of some new applications is shown below:

- 1. Cancer.** HNT has been shown to be effective in capturing circulating tumour cells in the bloodstream e.g. leukemic cells.
- 2. Drug release through transdermal patches.** Drugs such as stimulants and hormones can be applied using HNT. Fewer drugs per patch are required and improved delivery rates are possible.
- 3. Controlled, slow release of anti-bacterials, anti-septics, enzymes and proteins**
- 4. Slow release of glycerol in face creams to act as a moisturizer for skin care.**
- 5. Slow release of Chitosan in dental applications** such as toothpaste or fillings.
- 6. Slow release of anti biotic in PMMA (polymethylmethacrylate) bone cement.** The HNT component also brings improvements to mechanical properties such as tensile and flexural strength.
- 7. Wound Care.** HNT loaded with appropriate drugs can be embedded into the base layer of bandages. The treatment of burns is a good example where risk of infection and scarring is reduced.

## **Potential Side Affects**

As with all cures there are potential side affects! These include the absorption of useful nutrients, vitamins or drugs and eventual removal through the gut system and a reduced rate of absorption of such materials, due to particle coatings on the digestive tract.

## **Summary**

Clay minerals have been shown by a number of different research institutes to have great potential in curing various health problems. In particular the work done on HNT looks promising. HNT is confined to in - vitro testing at present with the exception of some face creams on sale in Europe and South Korea.

Full approval for internal use of new medicines by regulatory bodies such as the FDA and MHRA can of course take years.

Future commercial implications for suppliers are for low volumes but high value. Sales will be priced in lbs or kgs rather than tonnes.

## **The Author**

I have been involved in the manufacture and quality control of BP Kaolin at Goonvean Ltd for nearly 30 years and, more recently, with my partner Simon Warren at First Test Minerals Ltd, in the sale of small lots. This has given me a strong interest in the subject.

I welcome any questions or comments from anyone across the world, especially technical ideas, which might progress the development of minerals in this important sector. As an example, it ought to be possible to tackle viruses and bacteria such as MRSA and E Coli etc. using HNT loaded with trace amounts of the required heavy metals.

Frank Hart  
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