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Research Article

Powdered Water - A Compact Solution for Drought Stricken Farms

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Abstract

Droughts today are the biggest concern in today's ever growing world due to various environmental factors such as global warming, greenhouse effect to site a few. Due to this very reason a new cure has been discovered to curb this problem. A super absorbent polymer known as "SOLID RAIN" can be used to reduce this problem that mainly arises during the summer and winter seasons in various tropical and sub- tropical countries in many parts of the world. In this paper we will be talking about potassium polyacrylate used in the manufacturing of solid rain and how this chemical is capable of soaking water upto 500 times its size. We will also be talking about the various advantages of this new technology and how this product may prove to be the world's greatest success towards achieving an eco-friendly and ecological sustainable environment especially in the third world countries, so that future generations may also meet their needs.

Keywords: *Droughts, potassium polyacrylate, soaking, super-absorbent and mechanism.*

1. Introduction

When a region notes a deficiency in water supply either surface or underground water for an extended period of time due to climatic conditions this situation can be termed as drought. When a region receives a constant below average precipitation for a very long time (years) droughts are said to occur. Environmental factors may not be the sole cause for droughts, even human activities such as over farming, deforestation, over use of fertilizers and erosion which adversely affect the ability of land to capture and hold water. Sometimes a combination of both environmental factors and human activities may result in droughts. For this problem to be resolved a new technology recently developed can be used. This is known as powdered water.

Figure 1 Farm affected due to drought.

1.1 What is powdered water

Powdered water also known as rain is composed of potassium polyacrylate. This polymer can easily be retained in it for an entire year on addition to soil. This material can absorb water up to 500 times its size. On addition of this polymer to water we see water being converted into a thick, translucent gel type compound. A whole liter of water can be transformed into this gel like compound by using just 10 grams of solid rain. (David Cash *et al* 2007).

Figure 2 Solidified water crystals

1.2 Super Absorbent Polymer

Polymers consist of molecules having high molar masses and consist of a large number of repeating units. Polymers are formed by chemical reactions containing monomers which are joined sequentially, forming a chain. Super absorbent polymers (SAP) and Hydrogels are water-absorbing and water-holding materials.

The most important characteristic of these polymers are their ability to absorb and keep the surrounding area

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damp and not wet. This is done by forming a gel with the polymer. (David cash, *et al*, 2007)

Figure 3 Potassium Polyacrylate

2. Mechanism of absorption

A superabsorbent acts like a sponge. In addition to this ability these materials they also increase moisture availability. When water comes into contact with a superabsorbent, an electrical repulsion takes place within the particles. Then water is drawn into the particles resulting into the swelling of each particle. This water absorbent property of these polymers is due to the presence of potassium molecules that form bridges between the long hydrocarbon chains. These bridges are known as cross-linking. These bridges enable the polymer to form into a huge single super-molecule. These polymers have the ability to degrade in the environment and breakdown into simpler molecules.

Figure 4 Absorbent polymer crystals

2.1 Absorption Capacity

Absorption capacity of a substance can be defined as the maximum amount of water or liquid that a particular substance can absorb. The absorption capacity of super absorbent is affected by the following:

Acidity & alkalinity (pH)
Conductivity
Variables that inhibit expansion of the gel particles

The pH of the absorbed fluid does not generally pose a problem in most plant related applications since the pH and the growing environment is normally within the ideal range for optimum absorption.

2.2 Polyacrylate/Hydrogels

Polyacrylate is an example of hydrogels or super absorbents. They are called so as they have the ability to absorb and hold a large amount of water. Hydrogels use cross-linked polymers to absorb water. This superabsorbent material is widely used in the manufacturing of diapers for babies. At the present time only three superabsorbent gels are used commercially these are sodium polyacrylate, potassium polyacrylate, and polyacrylamide. The potassium polyacrylate and polyacrylamide are widely used as fire-blocking gels. The superabsorbent gel commonly used to absorb chemical spills is potassium polyacrylate. This superabsorbent is also used to absorb water and store it in the form of gel crystals.

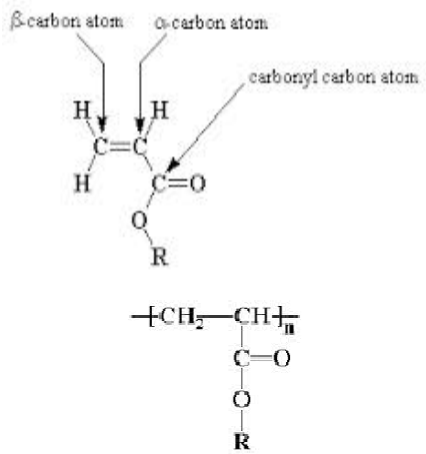

Figure 5 Structure of Polyacrylate

2.3 Synthesis of Polyacrylate

In the dry powdered state, the chains of the polymer are coiled and lined with carboxyl groups (-COON). When hydrated with water, the carboxyl groups dissociate into negatively charged carboxylate ions (COO). These ions repel one another along the polymer chain, thereby widening the polymer coils allowing water to move into contact with more carboxyl groups. As the polymer continues to uncoil the ultimate swelling forms a gel-like consistency. The polymer does not form a solution because it still has cross linking due to hydrogen bonding where hydrogen atoms in water are being attracted to the oxygen atom in the carboxylate ions between chains.

2.4 Characteristics of Super Absorbent Polymers

Superabsorbent materials have many characteristics and due to this very reason they are mostly used in the manufacturing of many household items all over the globe. Some of them include baby diapers, adult incontinence products, feminine hygiene products, paper towels, surgical sponges, and many more.

The characteristics of this polymer are as follows:
It is innocuous and can sop up water and release water time after time.

It can also absorb fertilizers, pesticides and release them slowly, swell the efficacy of them.

2.5 How do these water crystals work

Water Crystals absorb and hold water, storing it so that they can be used by the plants whenever required. In agriculture sector these hydrated crystals become reservoirs of moisture for plants during drought. They capture the excess irrigation in any type of gardening or farming, helping to keep the soil moist and creating a healthier growing environment. They will hold the water for extended periods of time until drained through transpiration.

Figure 6 Demonstration of use of powdered water for household gardening

When mixed or tilled into soil, water Crystals will absorb and retain excess water for a period lot longer than untreated soil is capable of doing. The extent of time depends on ambient temperature, humidity and the thirst of the plant(s) the soil feeds. The water is extracted through the roots of the plants as the plant is growing. If you squeeze a hydrated crystal, the polymer won't leak moisture as does a sponge. Instead, the hydrated polymer gel will break into smaller pieces or crystals. A water crystal will dehydrate back to granules smaller than their original size, but replenish as full as its maximum (Grazyna Bartkowiak, *et al*, 2006).

Figure 7 Powdered water mixed in soil ready to be cultivated

The crystals absorb and store dissolved nutrients from the surrounding soil. When hydrated, they supply water to plants. They do not drain water from plants or compete with them for moisture. Instead, hydrated crystals are gradually drained of water from the drinking plants and from ambient temperature. Then, when it rains or when the soil is irrigated, or the container plant watered, the Water Crystals will again absorb excess moisture. They are capable of continuing the process many times.

Figure 8 Solid rain in one hand & water crystals in the other

3. Advantages of solid rain

- Solid rain is a non- toxic and eco-friendly material which does not pose a threat while handling.
- It is easy use while cultivation of crop.
- It is tasteless, non-polluting to plants, soil and groundwater, flowers, fruits and trees.
- This material can be re-used on recovery from the soil.
- This product is not very expensive and can even be used in household gardens.
- This product enables the storage of water for 12 months.
- Improvement of soil structure is also an advantage of this material.
- Promotes microbial growth and can also improve the utilization of soil turnover efficiency.
- High speed of absorbing capacity ensures that water does not evaporate.

Conclusions and discussions

Super absorbent materials are versatile, natural, biodegradable and renewable products and have many commercial applications. They are found in many products used in our day to day lives. If these products are also used in the field of agriculture they will prove to be very helpful during times of drought and famine. Not only can they be mixed with the soil during cultivation, they can also be used for storing water during the summer season in many tropical and sub- tropical countries all over the world. These superabsorbent polymers are not only cost effective but they also offer many advantages over other conventional absorbents. This latest discovery is bound to play a very vital role in forthcoming decades.

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