A BIOPOLYMER BASED BIODEGRADABLE SUPER WATER ABSORBING POLYMER AND PROCESS FOR ITS PREPARATION

IITM Technology Available for Licensing

Problem Statement

- Super Water Absorbing Polymers (SWAP) or hydrogels **retain of large amounts of water for their weight**.
- Commercially available SWAPs used in diapers and agricultural hydrogels are **mostly made of non-biodegradable** cross-linked polyacrylamides.
- **Urea applied to agricultural fields get washed away or decompose** into ammonia at high temperatures and high humidity.
- **Water retention capacity** of hydrogels usually **decline rapidly under saline** conditions.
- There is a need for biodegradable SWAPs prepared using green methods that can be used for various applications.

Intellectual Property

- IITM IDF Ref. **1180**
- **IN 527192 - Patent Granted**

TRL (Technology Readiness Level)

TRL 5 -Technology validated in relevant environment

Technology Category/ Market

Category- Green Technology
Industry Classification:

- **NIC (2008)-20121-** Manufacture of urea and other organic fertilizers; **13996-** Manufacture of wadding of textile materials and articles of wadding such as sanitary napkins, tampons and diapers

Applications- Hydrogels, diapers, fertilizers, tissue engineering, concrete technology, drug delivery and biosensors.

Market report: The Hydrogel Market size is estimated at USD 23.16 billion in 2024, and is expected to reach USD 32.62 billion by 2029, growing at a CAGR of 7.10% during the forecast period.

Research Lab

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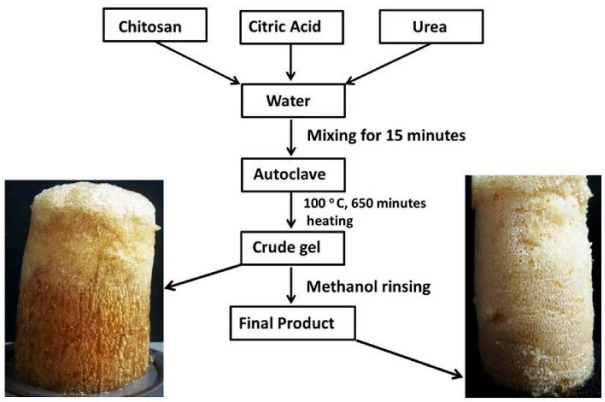

Figure: Process flow chart representing the preparation of CHCAUR

Figure: The biodegradable super water absorbent polymeric material made from chitosan, citric acid and urea (CHCAUR-labeled E) appears to be doing far better than the control (labeled C).

S.No.	Composition	N %	Water uptake (g/g)
1	CHEDUR (chitosan,EDTA and urea)	11.8	570
2	CHED (without urea)	8.4	6.6
3	CHUR (without EDTA)	10.4	2.8
4	CHCA (without urea)	7.46	30
5	CHCAUR (chitosan, citric acid and urea)	11.38	800

Figure: Comparative data of Water uptake of the\ polymeric material of the present invention vis-a-vis the raw materials.

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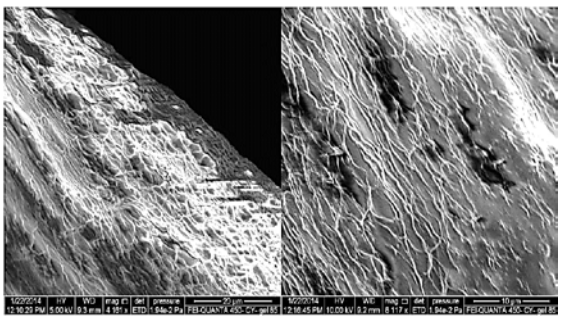

Figure: SEM images show formation of fibrous gel upon the absorption of water by CHEDUR

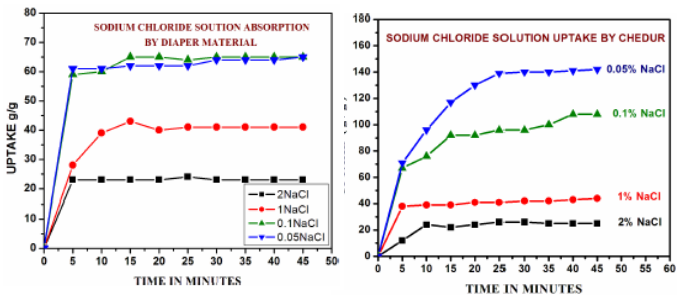

Figure: CHEDUR is a better water absorber at lower concentration of saline while it is equivalent to the commercial diaper material at higher saline content

Technology

1. A synergistic composition of biopolymers, chelating agents and fertilizers in a specific weight ratio of 1 :2:2 was found
2. The biopolymer was mixed in the weight ratio (1:2:2) to the fertilizer chelating agent mixture in a poly(propylene) bottle with an air-tight lid and heated to 100°C at a rate of 5°C per minutes for 650 minutes. The obtained material was cooled and washed with methanol.
3. Two types of biopolymer SWAPs were prepared- CHEDUR (Chitosan, EDTA, Urea) and CHCAUR (Chitosan, Citric Acid, Urea)
4. The process does not compromise on the biodegradability of chitosan, as no new covalent bond is added while the chelation property of the carboxylic acids is retained. Moreover, urea is present in a form that it can directly function as a fertilizer.
5. Comparing the CNMR spectrum the area under the peaks between 48 to 65 ppm (from C2 and C6 of chitosan as well as from EDTA) and 92 to 112 ppm (arising only from the anomeric carbon) the degree of crosslinking is found to be 0.16.

Key Features / Value Proposition

- The chitosan matrix degrades in soil with simultaneous release of urea, organic acid and metal ion in a restricted manner dictated by the biodegradation rate up to 45 days. Whereas, direct application of urea may lead to wastage due to run-off and decomposition to ammonia.
- CHEDUR shows water absorption over a period of 30 minutes with a maximum water uptake of 570 g/g, which is nearly 2.3 times that of the commercial diaper material used. Moreover, best water uptake is provided by using EDT A and citric acid as the chelating agent AT 800g/g.
- The developed SWAP is completely biodegradable and safe for plants. Whereas, conventional polyacrylamide based SWAPs (Pusa hydrogel) while being non-biodegradable can adversely impact plants if non-crosslinked polyacrylamides are present.
- The polymeric composition is cost effective since the raw materials used herein are abundantly available (chitosan from sea food waste)

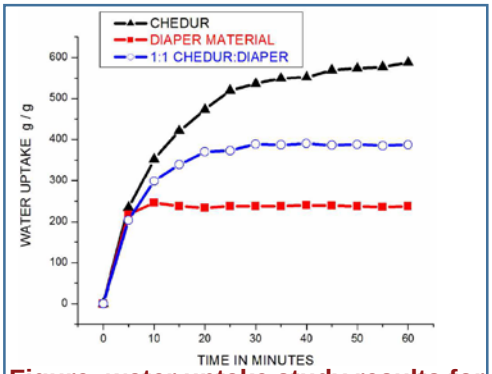

Figure: water uptake study results for CHEDUR, commercial diaper material and combination of CHEDUR with commercial diaper material

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