



# IIT MADRAS

Indian Institute of Technology Madras

Technology Transfer Office  
TTO - IPM Cell



## Industrial Consultancy & Sponsored Research (IC&SR)

### APPARATUS FOR REMOVAL OF METALS FROM WASTEWATER AND METHOD THEREOF

#### IITM Technology Available for Licensing

##### Problem Statement

- Generally, the toxicity of heavy metals like arsenic, lead, mercury, chromium etc. in the waste bodies pose a major threat to the environment and human life.
- Various industries discharges said heavy metals which find their way to contaminate the environmental matrices such as surface water, ground water and the soil phase.
- There are many remedies which are studied to handle the Cr (VI) waste by physical, chemical or biological means, there does exist limitation for each of them.
- Major issues of concern in all of those being the secondary pollution or the intermediates formed due to the pollutant reduction as they coexist in actual scenario.
- Hence, the present patent provides the solution to address the above issues.

##### Technology Category/ Market

**Chemical Engineering:** Electrochemical cell;

**Industry:** Electroplating, textile dyeing, paints, pigments and tannery industries, wastewater treatment plant, energy and power Industry.

**Applications:** Serve as a source of clean energy in several remote location, fuel cell or batteries, wastewater treatment plant.

**Market:** The global **electrochemical cell** market is projected to grow at a **CAGR** of **15.6%** during forecast period of **2021** to **2027**.

##### Technology

- Present patent describes about **an apparatus and a method for removal of metals from wastewater**.
- Said apparatus is defined as a **three chambered cell as anode – CEM-PBS-AEM-cathode** wherein PBS is **buffer chamber** shown in **Figures**.
- Three chambered cell is designed by separated ion specific membranes and electrolytes to

oxidize urea/cow urine spontaneously at anode and reduce Cr at cathode, shown in figures. The claimed electrochemical cell comprises:

1

- **An anode chamber with an anode in contact with an anolyte;**

2

- **A cathodic chamber with a cathode in contact with the metal containing wastewater;**

3

- **A buffer chamber containing the buffer solution positioned in between said anodic and cathodic chambers, wherein the anodic and cathodic chamber connected with to the buffer chamber through cation exchange membrane and an anionic exchange membrane**

- Finally, a means to extract the reduced metal.
- The membranes are configured in such a manner to maintain the pH of both anodic and cathodic chambers, as the reduction of Cr(VI) is highly pH dependent reaction.

##### Intellectual Property

**IITM IDF Ref. 1458;**

**IN Patent No. 373236 (Granted)**

**PCT Application No. PCT/IN2018/050412**

##### TRL (Technology Readiness Level)

**TRL- 3/4**, Proof of concept ready, tested and validated in laboratory.

##### Research Lab

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#### Key Features / Value Proposition

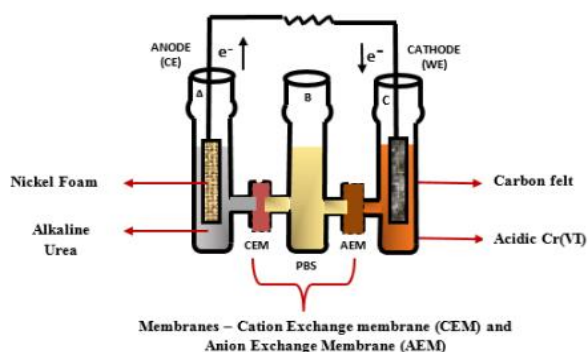
##### ❖ Technical Perspective:

1. In the patent literature, nickel foam as anode, cattle urine/urea as anolyte, and catalyst free carbon felt as cathode, chromium (III) as extracted reduced metal, and (phosphate prepared with  $K_2HPO_4$  and  $KH_2PO_4$ ) in distilled water as buffer solution was used and tested.

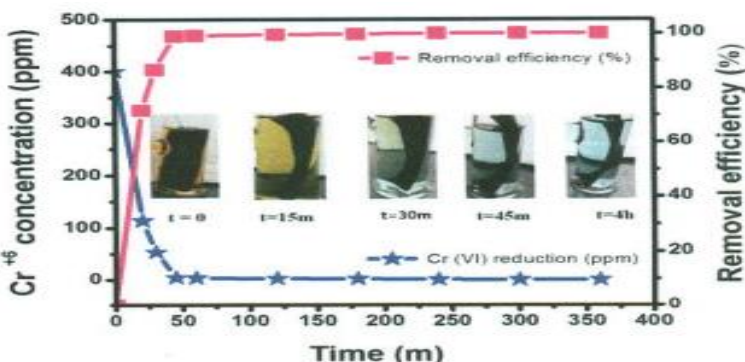
##### ❖ Industrial Perspective:

1. Alkaline anode and acidic cathode enhanced the reduction efficiency of different initial metal concentrations of Cr in a short interval of time; and the feasibility of using cow urine as an anolyte to evaluate the efficacy of Cr reduction.

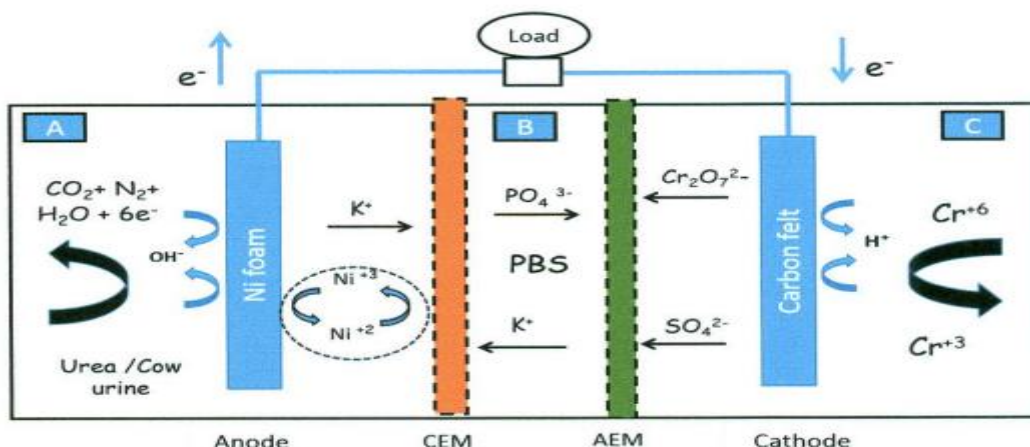
#### Images



**FIG.1A:** Shown a schematic representation of three chambered cell with electrodes.



**FIG.1B:** Shown removal efficiency of 400 ppm Cr(VI) dissolved in 0.5M  $H_2SO_4$  at a constant load of 1000 ohm at room temperature.



**FIG. 2 :** Illustrates anodic and cathodic mechanism in the three chambered H-cell with urea/cow urine as anolyte in chamber A, PBS in chamber B and 100 mg/L Cr(VI) in chamber C.

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