Science

The Sta
NEW DELHI WEDNESDAY 09 I

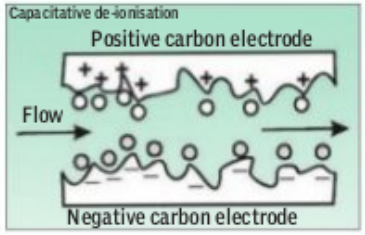
Scrubbing water clean

ITS CAPACITY AS A CLEANING AGENT IS WHAT MAKES IT A HOST TO CONTAMINANTS THAT ARE DIFFICULT TO REMOVE, WRITES **S ANANTHANARAYANAN**

Industry, pollution and the growing population together increasingly constitute both the demand for and scarcity of clean water. While river-fed sources are becoming less accessible, groundwater is also sinking deeper or getting contaminated.

Conserving and reusing the commodity has become vital and technology to turn bad water to good has become more important than ever. Marc Andelman, Massachusetts-based inventor, Professor Tony Cass from Imperial College, London, and Professor Sung Jae Kim from Seoul National University presented three new nano technology-based solutions for extracting potable water from inferior sources at the eighth India Nano Meet organised by the S&T Promotion Society, government of Karnataka, at Bengaluru on 8 March. The packed audience was of industrialists, start-ups and students and Professor T Pradeep of IIT, Chennai, who conducted the meeting, pressed for emerging technology to be picked up and used for the benefit of the country and the world.

Andelman's innovation is an improvement of the method called capacitative de-ionisation



the charged plates. The voltage used is low, and there is no current between the surfaces, but dissolved contaminants, which are split in the water medium into oppositely charged halves called *ions* drift to opposite ends till the ends collect full charge and their drifting stops. While the water that flows through gets purified when the charge is on, the surfaces can now be discharged to release a concentrate of contaminants for disposal. CDI, which extracts dissolved contaminants, is energy efficient compared to other methods like distillation or the now common *Reverse Osmosis*, which work the other way about, extracting water from a salt solution.

Andelman explained that the material of the electrodes had to be porges. This did improve efficiency, but the membrane is expensive and takes space in the water channel.

Andelman's innovation was to replace the membrane by directly coating the electrodes with a material that contained charged components that were drawn, half towards and half away from the charge on the electrodes. These separated charges create a layer that behaves like the *ion exchange charge barrier* in keeping down the counter-current of charges being released from the electrodes. This treatment, of creating a "polarised electrode", however, is a low-cost procedure and the electrodes themselves are nano-porous carbon, which could come from burnt coconut shells, Andelman said.

Measuring contamination

Professor Tony Cass, chemical biologist, explained that arsenic poisoning of ground water, which was notorious in Bangladesh, was in fact a monitor large numbers of water borings, particularly as arsenic levels could change within a very short period of time. "You cannot manage anything till you can measure it," Professor Cass said, citing a remark made about air pollution in London.

He said the current methods of measuring sugar levels in blood and urine of diabetics became an example to emulate in assessing arsenic levels. Testing for sugar used to be slow and cumbersome 30 years ago but it could now be done very easily, and fast, with a hand-held device by the patient. The secret of the advance was the discovery of an enzyme that reacted with glucose, and exclusively with glucose, to set free an electron, that formed a current that could be measured by a meter or a counter. A light pinprick to access the blood could then be automated to read out the glucose level, in a device that was now sold over the counter! And there is a strip of paper that can be dipped in

piration from coastal mangroves that flourish in salt seawater to devise ways of desalination as a source of fresh water for human consumption or irrigation. The current ways of largescale desalination are only distillation or reverse osmosis, both of which are power intensive. It is, hence, attractive to desalinate without the use of power, except sunlight, maybe, like nature.

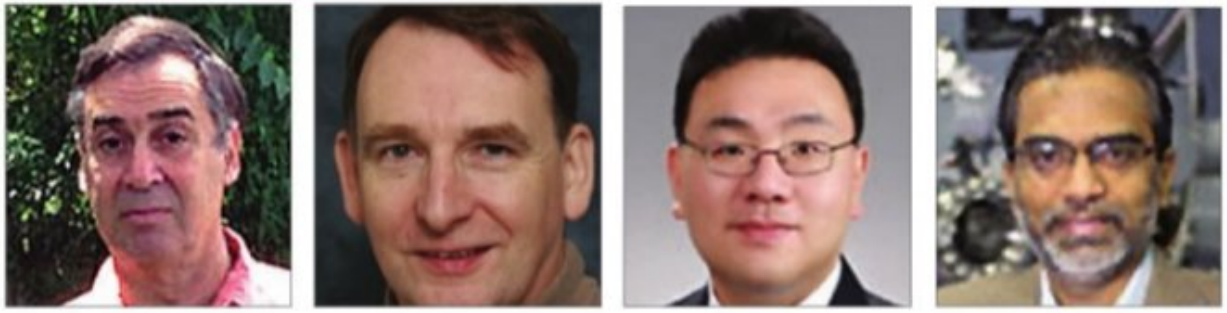
The process of osmosis is that when solutions of different concentration are separated by a semi-permeable membrane, which lets through the solvent but not the solute, the solvent is driven to pass from the lower concentration to the higher side. This driving force, in fact, can support a higher column of greater concentration, which is what happens in a coastal freshwater well, which supports the pressure of salty sea water whose level is higher. In reverse osmosis, physical pressure that is greater than the pressure of osmosis is exerted on the side of higher concentration to drive the solvent, water in the case of brine, to the freshwater side.

The roots of coastal plants, which stand in salt water, are able to keep out the salt and take in fresh water, which then rises with the sap to the stem and leaves, using capillary forces. The work of Professor Sung Jae Kim and colleagues identifies the role of capillaries, or very narrow channels, in attaining the separation of higher and lower concentrations, or an "ion concentration polarisation", leading to an "ion depletion zone" near nano-porous materials that is selectively permeable. A device based

citative de-ionisation, or CDI, where a pair of oppositely charged surfaces, the electrodes, fish out contaminants, mainly salt, from water that is made to flow between

Glucometer

ous so that there was high surface area and greater capacity to collect charge for the same voltage applied. A limitation of the basic design, however, was that when charged ions of the contaminant piled up very near the electrodes, oppositely charged ions were also inserted into the region just beyond, a region called the *diffuse layer*, and this reduced the efficiency of the extraction of contaminants. A first improvement has hence been to insert an *ion exchange membrane* that would not impede the movement of the contaminant ions but act as a barrier to the counter-current of opposite charproblem the world over. And the great difficulty in its management was the complexity of detection and measurement. It was, hence, a challenge to



Marc Andelman, Tony Cass, Sung Jae Kim and T Pradeep.

Professor Sung Jae Kim takes inspiration from coastal mangroves that flourish in salt seawater to devise ways of desalination as a source of fresh water for human consumption or irrigation.

urine and the colour shows the level of glucose.

Professor Cass, with his colleagues Joanne Santini and Thomas Osborne, chanced upon a similar action of an enzyme that set electrons free while changing arsenic salts from one form to another. They have now devised a method to build a simple instrument, like the glucometer for diabetics, which measures low levels of arsenic in water with good accuracy. "The device is not so good at high concentrations," he says, "but fortunately the area of interest is low contamination."

Bio-inspiration

Professor Sung Jae Kim takes inson this effect has been found to achieve 90 per cent reduction of salinity without an external power source. The group has carried out theoretical analysis and has come to a conclusion of methods to commercialise the process.

Getting to the market

Professor T Pradeep spoke of the scale of the problem of water, which would soon dwarf other crises that humanity faces. A very low level of contamination, just one part in 10^{13}, which works out to "one person in 10,000 times the Indian population", he said, rendered water unfit for use. To purify water affordably and on a large scale was, hence, a priority. There was a case to create an institution to support research and to help ideas to be quickly commercialised, he said. But Andelman later observed that "there is zero R&D money in the USA for water tech, neither government nor corporate". and he funded his own research by running a side business!

THE WRITER CAN BE CONTACTED AT
response@simplescience.in

PUNJAB OPPN STAGE WALK OUT IN ASSEMBLY

Water woes

STATESMAN NEWS SERVICE
Chandigarh, 8 March

The Budget session of the Punjab Assembly began on Tuesday with a walkout by Opposition Congress members over the Sutlej-Yamuna Link (SYL) canal issue. Led by Leader of the Opposition Charanjit Singh Channi, Congress MLAs staged the walkout amidst sloganeering.

The state government today said "injustice and discrimination" was meted out to Punjab over its river waters.

Addressing the Budget session of the state Assembly on its opening day, governor Kaptan Singh Solanki, also Haryana's governor, said Punjab's right to its river waters should be "safeguarded".

He appealed to the Centre to remove "discrimination" in sharing river water with neighbouring states".

Mr Solanki said Punjab government had been seeking a solution to the river water issue in consonance with Riparian Principle. The governor said the people of the state have also been heavily discriminated by refusal of the Centre to transfer Chandigarh to Punjab. "Several Punjabi speaking areas which was excluded from the state at the time of reorganisation in 1966 have still not been included in Punjab," he said.

Recently, a five-member Constitution Bench of the Supreme Court began hearing on the Presidential Reference pertaining to Punjab Termination of Agreements Act, 2004, over the SYL issue. The controversial legislation, passed by the then Punjab Assembly when Capt Amarinder Singh was the chief minister, had terminated all water-sharing agreements between Punjab and its neighbouring states, thereby jeopardising the construction of the Satluj Yamuna Link (SYL) canal.

Several Punjabi speaking areas which was excluded from the state at the time of reorganisation in 1966 have still not been included in Punjab

KAPTAN SINGH SOLAN

After the Supreme Court began hearing the SYL canal dispute, Haryana chief minister Manohar Lal Khattar had expressed hope the verdict would be in favour of his state. But Punjab chief minister Parkash Singh Badal maintains that the state "does not have a single drop of water to spare from its rivers". "The Punjab's stand on the subject has been consistent, clear and categorical and there can be no compromise on the rights of Punjab as a Riparian State," Mr Badal had said earlier.

SHARING OF RIVER WATERS Solicitor General says Punjab may cut Haryana's share, but can't cancel SYL treaty

SC rejects Punjab's plea on recusal

R SEDHURAMAN
LEGAL CORRESPONDENT

NEW DELHI, MARCH 8

The Supreme Court today rejected the Punjab Government's objection to Justice Adarsh Kumar Goel, who hails from Haryana, being part of a five-member Constitution Bench hearing the Presidential reference on the validity of the Punjab Termination of Agreements Act 2004.

The Centre today continued to question the logic behind the 2004 Act under which Punjab sought to cancel its agreements with neighbouring states, particularly Haryana, for sharing the Ravi, Beas and Sutlej waters. The other states involved in the reference are Rajasthan, Delhi, Himachal and J&K, besides the Centre.

Arguing for the Centre, Solicitor General Ranjit Kumar said if Punjab felt the flow of water in these rivers had dwindled, it could have reduced the share of other states on a pro rata basis, instead of trying to wriggle out of its commitments altogether. "We are rejecting this application," the Bench headed by Justice Anil R Dave told senior advocate Ram Jethmalani who argued for Punjab. The others on the Bench are Justices Pinaki Chandra Ghose, Shiva Kirti Singh and Amitava Roy. Jethmalani said Punjab wanted Justice Goel to opt out of the Bench as six SC Judges had done so in such sensitive cases in the recent past because they hailed from one of the states involved in the litigation over sharing of river waters. Punjab, in its application, had named the six Judges as Justices JS Khehar, HL Dattu and SS Nijjar (both retired), J Chelameswar, NV Ramana and Kurian Joseph. All had opted out without giving a chance to any of the states to raise any objection, Jethmalani said.

"Judges decide cases without any bias, love and affection," the Bench said. Jethmalani said "everything has become so dirty in politics these days" and as such Justice Goel's recusal would save a lot of embarrassment.

EDIT: POURING FIRE ON WATER

State's contention

- Punjab wanted Justice AK Goel, who belongs to Haryana, to opt out of Bench
- It argued that other SC Judges had done so in sensitive cases in the recent past as they hailed from one of the states involved in the litigation over sharing of river waters
- Punjab had named six Judges — Justices JS Khehar, HL Dattu and SS Nijjar (both retired), J Chelameswar, NV Ramana and Kurian Joseph; all of them had opted out, pointed out Jethmalani

Congress Legislature Party leader Charanjit Singh Channi (red turban with black band) and his party MLAs gherao Punjab Chief Minister Parkash Singh Badal at the Vidhan Sabha in Chandigarh on Tuesday. TRIBUNE PHOTO: MANOJ MAHAJAN

Cong MLAs boycott Guv's Address

RAJMEET SINGH
TRIBUNE NEWS SERVICE

CHANDIGARH, MARCH 8

The Budget session of the Punjab Vidhan Sabha started on a stormy note on Tuesday with Congress MLAs, wearing black bands and carrying black flags, walking to the Assembly, raising slogans against the SAD-BJP alliance for "not safeguarding" the state's interests on the river waters issue.

Raising slogans, the protesting MLAs walked out of the Assembly during Governor's Address.

"The Governor did not make any mention of farmers' suicide and atrocities on Dalits. The Address was identical to the one he made last year," alleged Congress Legislature Party leader Charanjit Singh Channi. He accused the Modi-led BJP government of betraying Punjab's interests by filing an affidavit in favour of Haryana.

He appealed to the CM to ask his daughter-in-law Harsimrat Kaur Badal to quit the Union Cabinet as a mark of protest.

Earlier in the day, stopped at the entrance of the Punajb Secretariat, Channi and Gidderbaha MLA Amarinder Singh Raja Warring broke the security cordon and made their way in. Stopped again outside the Assembly building, they sat on a dharna.

They demanded an FIR against the Punjab Police for "violating" the privilege of the elected representatives to enter the Assembly as well as the resignation of the Deputy CM, who holds the Home portfolio. Channi alleged that women MLAs were pushed around too. The Congress has moved a notice of breach of privilege against the Deputy CM.

The party passed a resolution terming the happenings as a" black day" in the history of Punjab.

SPECIAL COVERAGE P2

Punjab's interests bargained: Oppn

Accusing the state Badal government of selling the interests of Punjab on sharing of river water with neighbouring states, Congress MLAs wear black bands in protest

Breach of privilege notice against Dy CM

Congress seeks resignation of the Deputy CM, who holds the Home portfolio, for alleged manhandling of its MLAs; Party moves notice of breach of privilege against Deputy CM

Pouring fire on water

Keep SYL passions limited to courts, off streets

WATER is a commodity no one can survive without, and an agricultural region particularly can never have enough of it. Whipping up passions over access to water is thus the quickest way to create a following. There is no dearth of leaders in Punjab and Haryana who have built reputations on defending their respective state's interest in the water sharing issue, specifically the SYL Canal dispute. Capt Amarinder Singh, as Chief Minister of Punjab in 2004, ran away with the title of lead protester of the state with his one-sided reneging of all contracts on water sharing with neighbouring states. The constitutionality of his action is before the President, who has referred the matter to the Supreme Court.

The political one-upmanship, however, can mean a cost to be paid by the states involved and their people. The election season has come early to Punjab. But Haryana, convulsed by the Jat agitation, seems to have found the SYL dispute handy — to fight fire with fire. In the midst of a running feud with the state's farming community, the BJP government in Haryana decided to seek an urgent hearing on the water dispute in the Supreme Court. Promptly, the government of the same party at the Centre took a stand seemingly favouring Haryana. It is a legal matter with constitutional implications for inter-state and Centre-state relations. Yet, it is hard to avoid political interpretations of decisions that affect large swathes of population.

The "Punjab farmers' party" SAD, a BJP ally in the state, is in a difficult spot, and Capt Amarinder Singh sees an opportunity in its discomfort. That would be fine if he were not to ratchet it up to a level beyond political. He has called upon Punjabis to be prepared for "all sacrifices" to protect their interests. Between Haryana Chief Minister Khattar and him, they could end up pitting the farming communities of the two states against each other. That would be nothing less than sinister — Punjab has known a dark period, and Haryana has just experienced the choking grip of communalism. What can be sorted out in courts and legislatures should not be sought to be settled in the streets.

THE HINDU

CITIES » DELHI

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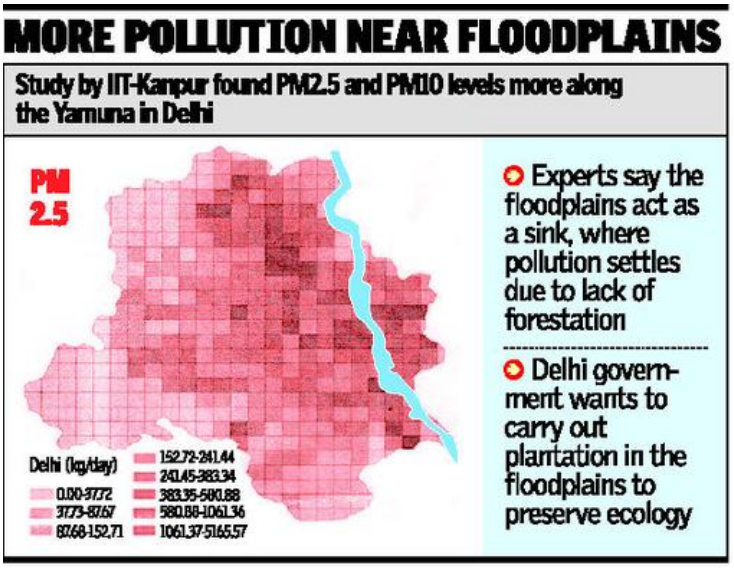
Pollution remains in floodplains due to sink effect: study

- Damini Nath



: Levels of air pollution, including harmful particulate matter , are higher in and around the floodplains of the Yamuna, which should ideally be home to rich eco-systems.

The Yamuna floodplains are at the centre of an ongoing debate about their use, with environmentalists opposing a massive cultural fest that will be held there by the Art of Living Foundation from Friday.

While the National Green Tribunal (NGT) is hearing a petition filed by Manoj Misra to shift the venue of the World Culture Festival, experts are saying that the floodplains of the Yamuna have been neglected and encroached upon in Delhi.

Now, a soon-to-be-released study has found that the distribution of fine particulate matter (PM2.5) and coarse particulate matter (PM10) is more in the area around the floodplains. The source apportionment study of PM 2.5 and PM10 done by the Indian Institute of Technology-Kanpur, commissioned by the Delhi government, included a spatial distribution of the pollutants.

“As per the study, we saw that PM levels were higher along the floodplains,” said Ashwani Kumar, the Environment and Forest Department Secretary.

Mr. Kumar added pollution from human activity, vehicles and industries around the floodplains were to be blamed. Due to a ‘sink effect’, the pollution remains in the floodplains.

“Had there been more plantation in the area, the moisture would have been more. That would have made the PM settle. Planting more trees will also act as a barrier. Polluted air mass can travel for days, but trees can stop it,” said Mr. Kumar.

The Environment and Forest Department has made its intention to carry out plantation in the floodplains clear via an ongoing case in the High Court, and also informed the NGT on Tuesday that it would be open to plantation at the site of the Art of Living event.

Environmentalists say that the floodplains of the Yamuna have been allowed to be neglected over the years.

“A total of 97 sq. km of floodplains in Delhi were notified as wetland, but because of illegal construction, it has shrunk to about 65 sq. km,” said Vinod Jain, a conservationist.

The floodplains could have saved Delhi 200 million gallons of water per day had they been used to make reservoirs, said Mr. Jain.

अब हर व्यक्ति को मिलेगा 25 लीटर पानी

पत्रिका-9-3-16

जल संसाधन मंत्रालय ने तैयार किया कानून का प्रारूप

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भविष्य में देश के प्रति व्यक्ति को अनिवार्य रूप से प्रतिदिन 25 लीटर पानी मिलने का अधिकार होगा। यही नहीं यह भी सुनिश्चित किया जाएगा कि प्रत्येक व्यक्ति के घर के आसपास जल की उपलब्धता हो। केंद्रीय जल संसाधन मंत्रालय ने राष्ट्रीय जल ढांचा कानून का प्रारुप तैयार किया है।

प्रारूप के अनुसार सबकी जल तक पहुंच तथा पानी के पीने और अन्य उपयोगों जैसे साफ-सफाई, कृषि एवं उद्योग के लिए पानी की मात्रा के आधार उचित शुल्क सुनिश्चित करने के लिए प्रत्येक राज्य द्वारा जल विनियामक प्राधिकरण की स्थापना की जाएगी।

राज्य की दक्षता के हिसाब से

प्रारूप के अनुसार संबंधित राज्यों में जल संसाधन योजनाएं राज्य की दक्षता को ध्यान में रखकर तैयार की जाएगी। साथ ही इसके लिए राज्य की तकनीकी आर्थिक विषयों के अलावा सामाजिक व पर्यावरणीय पहलुओं पर भी ध्यान देना होगा। जल आपूर्ति, स्वच्छता ठोस अपशिष्ट प्रबंधन ओर जल निकासी के लिए नए मानकों को लागू किया जाएगा। इसके अलावा उद्योगों को यह सुनिश्चित करना होगा कि उनके द्वारा उपयोग में लाए जाने वाले पानी का समुचित उपयोग करने के साथ-साथ उपयोग किए गए जल का परिशोधन अनिवार्य रुप से किया जाए। प्रारुप में यह भी प्रस्तावित है कि राज्य व केंद्र में विभिन्न विभागों के बीच समन्यव स्थापित करने के लिए बकायदा एक उच्चाधिकार प्राप्त सामिति का गठन किया जाए।

नदी संरक्षण भी

जल संसाधन मंत्रालय से मिली जानकारी के अनुसार प्रारुप में जल की सुरक्षा संरक्षण एवं विनियमन सुनिश्चित किया जाएगा। इसके अलावा अपशिष्ट जल के पुनः उपयोग, जल संसाधन पर जलवायु परिवर्तन के संभावित प्रभाव, नदी संरक्षण की भी व्यवस्था भी की गई है।