JSA Newsletter

Jaffna Science Association, Jaffna, Sri Lanka

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In this Issue :

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Chief Editor/JSA

..... From Editor's pen

Greetings All:

Welcome to our second newsletter for 2017-18. This news-letter also provides me with a chance to reflect on what the Association has been able to achieve in second quarter of this year 2017-18. Thanks to those of you who contributed to it as these contribution are essential to the newsletter's success.

First of all I would like to congratulate the sections those who have done great job in organizing successful activities during this quarter. In this Newsletter, we have included an article entitled "Carbon dioxide capture and utilization" by Ms. Kajana Thirunavukarasu, Demonstrator, Department of Chemistry, University of Jaffna. I would like to thank her for her contribution. This issue also carries the details of the newly joined life newspaper articles published by section A, and the winners of the quiz conducted by Section A.

As your newsletter editor, I welcome your articles, photographs and input to help keep the newsletter and website entertaining and informative. Please send your information to: srtharsha12@gmail.com

Thank you.

Shiva Rasalingam

The Chief-Editor/JSA

The JSA

The JSA was established in 1991 by the founder President late Prof. A. Thurairajah

Would you like to contribute to your Community?

Need an appropriate platform for executing your ideas?

Become a LIFE MEMBER of JSA today!

The primary objectives of the JSA are dissemination of scientific knowledge among the intellectuals in Jaffna region, encouraging national as well as regional research studies and presenting them in the Jaffna society, and advancement of scientific knowledge among the secondary school students and at the undergraduate level.

Sectional Activities

Section C:

Third popular talk on "Why Gender Equality?" held on 2nd August 2017 in Lecture hall I, Faculty of Medicine, University of Jaffna. Ms Jeeva Perumalpillai-ESSEX, a Retired Regional Manager, World Bank-South Asia served as the resource person.

Details of News Paper Article published by JSA-Section A in Valampurii

Date	Title	Author / Affiliation
04-08-2017	சுவட்டு எரிபொருட்களின் தேய்வும்... மீள்சக்திமுதல்களின் உயிர்ப்பும்....	த. ராஜரமணன் செய்முறைக் காட்டுனர் இரசாயனவியற்றுறை, விஞ்ஞான பீடம் யாழ். பல்கலைக் கழகம்
18-08-2017	அடமறந்திட்டேனே... ஞாபக மறதி	காலிங்கராசா ஹரிச்சந்திரா தொழிநுட்ப அலுவலர், மீன்பிடியியல் விஞ்ஞான துறை, விஞ்ஞான பீடம், யாழ் பல்கலைக்கழகம்.
01-09-2017	புகழுக்கும் இறுதி உண்டோ...? – பாராட்டுவோம் புகழ்வோம்	காலிங்கராசா ஹரிச்சந்திரா தொழிநுட்ப அலுவலர், மீன்பிடியியல் விஞ்ஞான துறை, விஞ்ஞான பீடம், யாழ் பல்கலைக்கழகம்.
15-09-2017	"கற்றது கைம்மண் அளவு, கல்லாதது உலக அளவு" – ஏடகம்	காலிங்கராசா ஹரிச்சந்திரா தொழிநுட்ப அலுவலர், மீன்பிடியியல் விஞ்ஞான துறை, விஞ்ஞான பீடம், யாழ் பல்கலைக்கழகம்.
29-09-2017	பழமொழிகளில் அறிவியற் சிந்தனைகள்	ஆ. செல்வதாஸ் யா/உடுத்துறை மகாவித்தியாலயம்
13-10-2017	அக்டோபர் - 1	காலிங்கராசா ஹரிச்சந்திரா தொழிநுட்ப அலுவலர், மீன்பிடியியல் விஞ்ஞான துறை, விஞ்ஞான பீடம், யாழ் பல்கலைக்கழகம்.
27-10-2017	வளிமண்டல மாசாக்கம் தொடர்பான பிரச்சினைகள்: அமில மழை, ஒளி இரசாயனப்புகார்	கே. வாணிமுகுந்தன், பிரதி அதிபர் யா/மெதடிஸ்த பெண்கள் உயர்தரப் பாடசாலை

JSA Membership

LIFE Member	–	LKR 2000
Ordinary Member	–	LKR 500
Student Member	–	LKR 100

Eligibility: Applicant should be a Graduate from a recognized University in Sri Lanka or Abroad in any field. Application forms are available in the JSA website.

Details of the Quiz winner

Quiz No	Date	Winner
189	04-08-2017	ந. கேசஞ்சா யா/யூனியன் கல்லூரி தெல்லிப்பளை
190	18-08-2017	கு. உமாகாந் 793 நாவலர் வீதி, யாழ்ப்பாணம்
191	01-09-2017	கே.இராஜகோபால் அடைக்கலம் தோட்டம் கந்தசுவாமிகோயிலடி வட்டுக்கோட்டை.
192	15-09-2017	கு. உமாகாந் 793 நாவலர் வீதி, யாழ்ப்பாணம்
193	29-09-2017	கே.இராஜகோபால் அடைக்கலம் தோட்டம் கந்தசுவாமிகோயிலடி வட்டுக்கோட்டை.
194	13-10-2017	தெ. இராஜரட்ணம் மடத்தடி ஒழுங்கை கல்வியங்காடு
195	27-10-2017	கார்த்திகேயன் சசிதரன் சர்வோதய வீதி ஆவரங்கால் மேற்கு

Condolence message

Retired Professor V Navaratnarajah
Former President of Jaffna Science Association (JSA)

With immense sorrow, we share the news of the demise of Retired Professor Navaratnarajah.

Professor Navaratnarajah was one of the founder members of the JSA. He served as the President of JSA (1995 – 1997) during the most difficult time in the history of JSA as well as in the lives of residents of the Jaffna Peninsula due to the undesirable conditions prevailed in the region.

The members of JSA will always remember his contributions towards strengthening the JSA.

He passed away on the 19th of August 2017 in Singapore. The funeral was held on the 21st of August 2017 in Singapore.

May his soul rest in peace!

Sections of JSA

Section A :
For Pure Sciences

Section B :
For Applied Sciences

Section C :
For Medical Sciences

Section D :
For Social Sciences

Activities of JSA

Organize annual School Science programmes

Organize annual conference on a timely topic

JSA Sectional Activities

Arrange popular talks to update people with present happenings

Organize workshops to empower people

Publish a magazine called '***Pirayoga Vingnana Sudar***' and Newspaper articles to disseminate knowledge

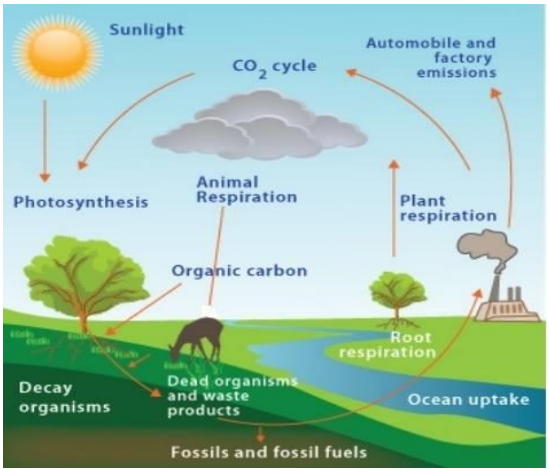
Life Members

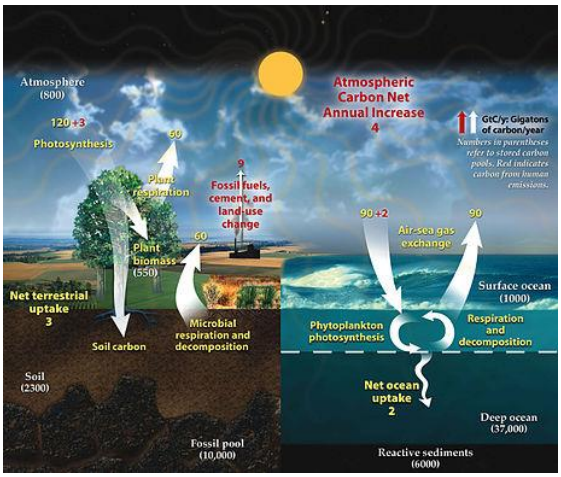
No	Date	Folio Number	Name	Affiliation
1	28.08.2017	JSA/A/L/2017/147	Ms. S. Thavakeeswaran	J/Jaffna Hindu Ladies' College
2	28.08.2017	JSA/A/L/2017/148	Mr. T. Sasirankan	Mu/Yogapuram Maha Vidyalayam
3	19.09.2017	JSA/A/L/2017/149	Mr. A. Paranthaman	Dept. of. Physics, University of Jaffna
4	19.09.2017	JSA/A/L/2017/150	Mr. K. Vanimukunthan	J/Methodist Girls' High School
5	19.09.2017	JSA/A/L/2017/151	Mr. J. Uthayan	J/Velanai Central College
6	19.09.2017	JSA/A/L/2017/152	Mr. S. Sureshkumar	Kn/Pallai Central College
7	19.09.2017	JSA/A/L/2017/153	Mr. S. Sridaran	Mn/St. Xavier's Girls College
8	19.09.2017	JSA/A/L/2017/154	Mr. A. S. Paranthaman	V/Vavuniya Tamil Maha Vidyalayam
9	19.09.2017	JSA/A/L/2017/155	Mr. S. Sivakaran	V/Nellukulam Kalaimahal Vidyalayam
10	19.09.2017	JSA/A/L/2017/156	Mr. P. Dharmananth	V/Vavuniya Tamil Maha Vidyalayam
11	19.09.2017	JSA/A/L/2017/157	Mr. S. Aravinthan	J/Karainagar Hindu College
12	23.10.2017	JSA/B/L/2017/159	Mr. B. Banujan	Faculty of Technology , University of Jaffna
13	11.10.2017	JSA/D/L/2017/158	Mr. R. Umanakenan	Dept. of Commerce, University of Jaffna

Carbon dioxide Capture and Utilization (CCU)

Kajana Thirunavukarasu
Demonstrator, Department of Chemistry,
University of Jaffna

Carbon dioxide was the first gas to be described as a discrete substance. In about 1960, the Flemish chemist Jan Baptist van Helmont observed that the mass of the resulting ash was much less than that of the original charcoal, when he burned charcoal in a closed vessel. His interpretation was that the rest of the charcoal had been transmitted into an invisible substance he termed a “gas” or “wild spirit”. CO_2 is a colourless and odourless gas vital to life on earth.





Please send your comments, suggestions, and articles for the next issue to
Dr. (Miss.) S. Rasalingam, Chief Editor/JSA, Department of Chemistry, University of Jaffna

The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. Along with the nitrogen cycle and the water cycle, the carbon cycle comprises a sequence of events that are key to making the Earth capable of sustaining life; it describes the movement of carbon as it is recycled and reused throughout the biosphere. This diagram of the fast carbon cycle shows the movement of carbon between land, atmosphere, and oceans in billions of tons per year. Yellow numbers are natural fluxes, red are human contributions, white indicate stored carbon.

Natural Sources (Decomposition of organic matter, Volcanic eruption, Oceans, Forest fires, Animal plant respiration) and Manmade Sources (Agricultural practices, Power generation, Chemical production, Petroleum production, Industrial sources) are the main sources, increase the CO_2 level in the atmosphere. A recent forecast for the period 2004 – 2030 suggest,

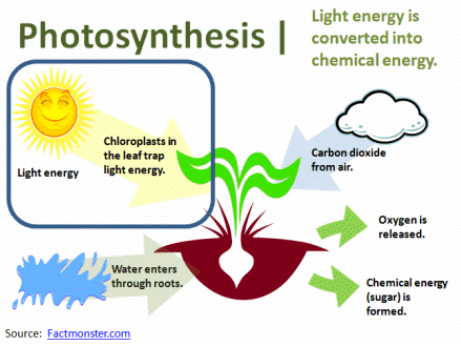
- Global primary energy demand will rise by 53%, leading to a 55% increase in global CO_2 emissions related to energy.
- Fossil fuel will remain a dominant source of energy worldwide.
- Emissions from power generation will account for 44% of global energy related emissions by 2030.

CCU is an emerging technology. It allows CO_2 to be separated, liquefied and stored to reduce emissions on a large scale. CCU reduces 80-90% CO_2 emission into atmosphere. Capture, compression and transportation of CO_2 requires much energy. Major challenge in the implementation of CCU is to address the high cost of CO_2 separation. CO_2 was captured and utilized in 3 ways. Those are chemical (photosynthesis, human efforts) biological and mineralization.

Chemical fixation of CO_2

1. *Photosynthesis*

   Here the light energy is converted to chemical energy and the figure clearly illustrate the mechanism of CO_2 conversion.



2. *Human efforts*

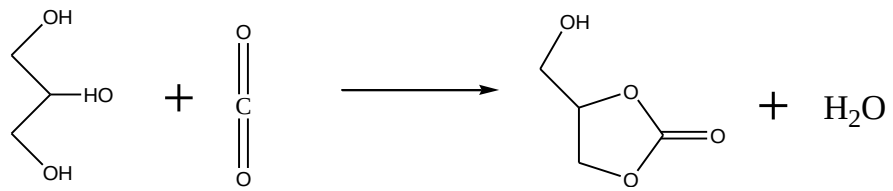
   (i) <u>Conversion of CO_2 into fuels</u>
   Carbon dioxide released from fossil fuel power plants, cement factories and industrial factories are used to produce fuels for vehicles, such as gasoline, jet fuel, diesel fuel, methane, propane etc. In a fuel cell, the fuel is supplied to the anode, while air (or oxygen) is supplied to the cathode. The anode and cathode contain catalysts that cause the fuel to undergo oxidation that generate positive hydrogen ions and electrons. The hydrogen ions are drawn through the electrolyte after the reaction.

At the same time, electrons are drawn from the anode to the cathode through an external circuit, producing direct current electricity. At the cathode, hydrogen ions, electrons, and oxygen react to form water (H_2O).

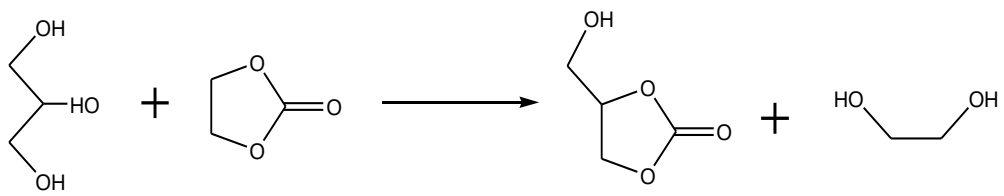
(ii) <u>CO_2 to polymeric/construction materials</u>

Copolymerization of monomers such as azetidines and aziridines with CO_2

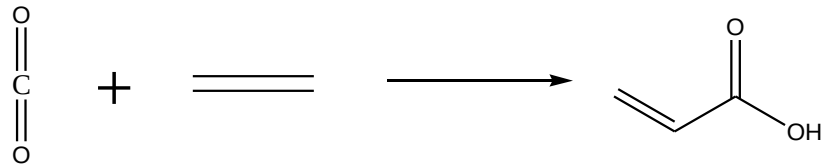
a. Direct coupling reaction between CO_2 with glycerol
Glycerol is a theme of great industrial interest as glycerol is formed in large amounts.



b. Trans esterification of glycerol with simple cyclic carbonate



c. Coupling of CO_2 with ethylene



3. *CO_2 to fine/pharmaceutical chemicals*
Many chemical, electrochemical and biological reactions involving CO_2 as a starting material have recently been explored. Production of chemicals from CO_2 ranges from commodity to bulk levels. Fixation of CO_2 gives various chemicals such as,
   i. Urea
   ii. Ethene
   iii. Benzoic acid

Biological fixation of CO_2 - Algal cultivation

Biological mitigation of CO_2 relies on photosynthesis by green plants or algae. In this process organic compounds are synthesised from carbon dioxide and water powered by energy derived from sunlight. The resulting biomass can be used for electricity generation or as raw material for production of transportation fuels, bio-based chemicals and materials.

An option for direct capture and utilisation of CO_2 emitted from point sources could involve the cultivation and processing of plants growing in an aquatic environment especially microalgae. They use sunlight as their energy source, and CO_2 and inorganic nutrients (mainly N-compounds (NO^{3-}, NH^{4+}) and phosphates) for growth. Even though CO_2 utilisation through algae has advantages and potential, there are several major challenges. Even at higher productivities microalgal systems have a substantial land requirement, which may not be available in the direct surroundings of power plants. Furthermore, costs are still high.

Mineralization

Material fluxes and process steps for CO_2 mineralization. This process is coupled with industrial waste conversion, mineral processing and energy recovery. Phosphogypsum (PG) is a large-scale industrial waste. CO_2 mineralization was used to convert the PG to $CaCO_3$ and $(NH_4)_2SO_4$.

$$CaSO_4.2H_2O_{(s)} + 2NH_{3(aq)} + CO_{2(aq)} \rightarrow (NH_4)_2SO_{4(aq)} + CaCO_{3(s)} + H_2O_{(l)}$$

- Used as a construction material and a fertilizer.
- Steel slag containing CaO or portlandite [$Ca(OH)_2$] is an industrial waste from steel plants.

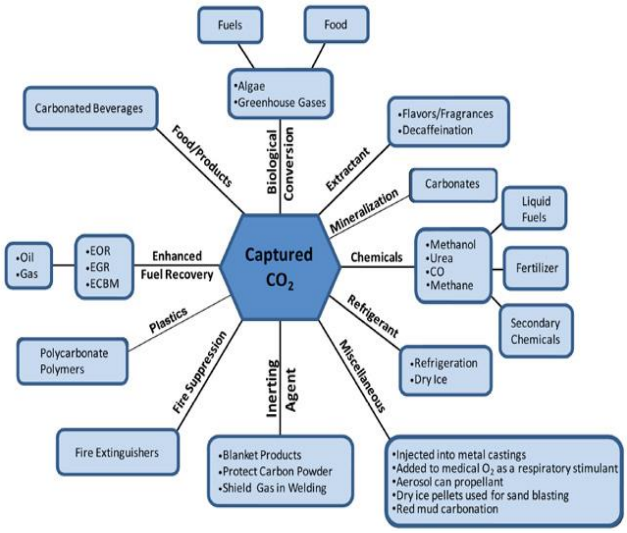
$$CaO_{(s)} + CO_{2(g)} \rightarrow CaCO_{3(s)}$$

- Produce construction material and generate power by CO_2 mineralization.

Utilization

1. **Refrigerant**

   CO_2 has several unique thermo physical properties that includes, very good heat transfer coefficient, relatively insensitive to pressure losses, very low viscosity, and these properties help to use this as refrigerant.



2. **Dry Ice**

   Dry Ice is frozen carbon dioxide. Used for freezing, and keeping things frozen in very cold temperature: 109.3^0 to -78.50. Dry Ice gives more than twice the cooling energy per pound of weight and three times the cooling energy per volume than regular water ice. Sometimes dry ice is packed in the top of a shipping container offering extended cooling without electrical refrigeration equipment and connections.

3. **Beverages**

   Carbon dioxide gas is used to carbonate soft drinks, beers and wine. Frozen solid carbon dioxide, in the form of dry Ice is used for the refrigeration of foodstuffs,

especially ice cream, meat products and frozen foods. In addition, dry ice is used for the following applications:

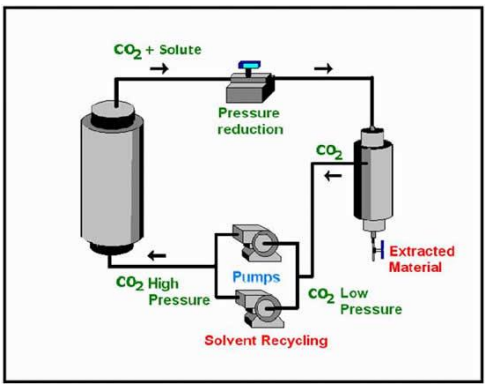
- Dry Ice pellets are used to replace sandblasting when removing paint from surfaces.
- It aids in reducing the cost of disposal and clean up.
- Dry Ice is used to chill aluminium rivets. These harden rapidly at room temperature, but remain soft if kept cold with dry ice.

4. **Fire extinguisher**

Carbon dioxide extinguishers work because carbon dioxide molecules are heavier than oxygen molecules. When the liquid carbon dioxide inside the extinguisher expands into a gas, the carbon dioxide pushes out any oxygen surrounding the fire. Without oxygen available to fuel the chemical reaction, the fire goes out quickly.

In addition to carbon dioxide extinguishers, fire extinguishers use other methods to put out fires. Wet extinguishers spray a liquid that absorbs heat, similar to pouring water on a campfire. These extinguishers are not suitable for chemical or electrical fires since the liquid can conduct electricity and cause flammable agents to spread. Other extinguishers coat the fuel, forming a barrier between the flammable material and the oxygen in the surrounding air. These are suitable for all types of fires, but the chemicals involved can be expensive and dangerous.

5. **Supercritical Fluid Extraction (SFE)**



SFE is a relatively new extraction process that has attracted great interest in many industries. Supercritical fluid properties are used selectively to extract specific components. Carbon dioxide is the most beneficial SCF used in extraction

Its non-toxic and non-combustible properties make it environmentally friendly. Supercritical CO_2 has a higher density and lower critical parameters than most of the other SCFs. CO_2 is readily available in high purity and is therefore, inexpensive to purchase. Supercritical CO_2 is the most popular and inexpensive solvent used in industry today.

References

- Baysal, T., Ersus, S. & Starmans, D.A.J. (2000), Supercritical CO_2 extraction, *Journal of Agricultural Food Chemistry*,Vol.48, pp. 5507-11
- S.C.E.Tsang et al,Wolfson Catalysis Centre,Inorganic Chemistry Laboratory,Recent Advances in CO_2 capture and Utilization,Journal of ChemSusChem 2008
- Malte Behrens,behrens@fhi-berlin.mpg.de,Utilization of CO_2,Lecture series:Modern Methods in Heterogeneous Catalysis Research
- Peter Styring,Daan Jansen(ECN),Carbon Capture and Utilization,The Centre for Low Carbon Futures 2011
- Ronald Michell,Japan,Environmental & Chemical Plant Project Department,An Overview of Re-use and Aplication of CO_2, Mitsubishi Heavy Industries