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SPRAY CANNON IN THE FORM OF FOG & MIST NEBULISES DUST IN MICRO WATER DROPLETS

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ABSTRACT

The Spray Cannon is a fog/misting machine that produces a curtain of micro-water droplets. The curtain suppresses dust in open spaces by binding dust particles in the air so they fall to the ground through gravity (air cleansing). The dust suppression cannon is an environmentally friendly and efficient way to suppresses dust at crushing sites, demolition sites, mining or when handling raw materials and cross-docking bulk goods, such as coal and ore.

KEYWORDS: Dust, Atomizer, Spray Cannon, Fog Cannon, Mist Cannon.

INTRODUCTION

Dust is made of fine particles of solid matter. On Earth, it generally consists of particles in the atmosphere that come from various sources such as soil lifted by wind (an aeolian process), volcanic eruptions, and pollution. Dust in homes is composed of about 20–50% dead skin cells. The rest, and in offices, and other human environments is composed of small amounts of plant pollen, human hairs, animal fur, textile fibers, paper fibers, minerals from outdoor soil, burnt meteorite particles, and many other materials which may be found in the local environment. A dust cannon, is a machine used for suppressing dust. A dust cannon creates a fine mist of water using a special jet nozzle that's located in the front of the cannon.

Figure-1: Günther Schaidt [Inventor of Fog Cannon].

Water mist cannon spraying machine is a kind of machine which can spray water and pesticides and other chemicals to disinfecting schools, and streets to protect the environment from the polluting of dust.

The intelligent controller mainly include: high pressure dust fan, water pump, nozzle, electric control box, remote control receiver, speed reducer, electric hydraulic push rod, rotating mechanism and the base.

The mist of water/liquid is driven by a strong air flow created by a fan that is spinning in the back of the cannon barrel. In the 1970s, Günther Schaidt developed the fog machine as we know it today. This invention greatly improved the safety, ease, and precision of smoke and steam effects on theatre and other stages. Dust cannons create a fine mist using jet nozzles located on the front of the cannon head. The mist is driven forwards with a strong air flow generated by an axial fan at the rear of the cannon. The mist binds with dust particles in the air, bringing them to the ground and keeping the air free of dust. Normally no dust suppressant chemicals are needed to suppress dust and most cannons are driven with electricity and work solely with water. A dust cannon normally is normally used within industries that creates dust.

Examples of such industries can be

- Mining
- Construction and demolition work
- Quarries
- Steel plants
- Coal yards
- Ports

The Cloud Tech Fog Cannon has been designed to tackle the problem of airborne dust particles generated by open mining activities, general demolition work and bulk material handling Fog Cannon has been shown to suppress up to 95% of airborne dust particles. The smaller units are ideal for suppressing dust where it is generated in high concentrations at easily defined point sources such as discharging onto stockpiles, discharging into ships, reclaiming from stockpiles, dumping, crushing and loading/unloading trucks. In this case the Fog Cannon is directed at the point source of dust and it rapidly suppresses the emitted dust before it can disperse. The larger units are where Fog Cannon are unique, as they are able to suppress general airborne open area dust through fogging the general area. The larger units are also capable of suppressing dust caused by high volume dust events such as blasting - and the long throw distance is usually necessary for this. Fog Cannons are also useful for dust suppression of stockpiles where their low water use is an advantage.[1]

Mist Cannons are the ultimate tool for large-scale dust suppression. By means of a powerful turbo-fan, they project a plume of finely-atomized water droplets into the air to suppress dust effectively over wide areas, before it disperses into the environment.

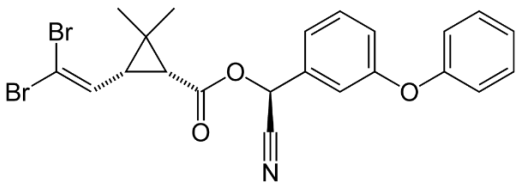

Figure-2: Fog cannon.

A Deltamethrin is a pyrethroid ester [CAS: 52918-63-5] insecticide. Deltamethrin [(S)-Cyano(3-phenoxyphenyl)methyl (1R,3R)-3-(2,2-dibromoethen-1-yl)-2,2-dimethylcyclopropane-1-carboxylate] plays a key role in controlling malaria vectors, and is used in the manufacture of long-lasting insecticidal mosquito nets; however, resistance of mosquitos and bed bugs to deltamethrin has seen a widespread increase. Fog is a high-powered fan or jet with specially engineered nozzles sprays dust suppressants to bind dust particles. The fogging process involves the action of fog nozzles which nebulize water into very small micro-droplets of water under pressure. The fog drives airborne dust particles to the ground and wets the surface to prevent fugitive dust particles. The water atomized mist produced has a small particle size range and its particle

size can even be less than 10 microns. When water is combined with dust in the air, due to the adhesion of the surface of water molecules, it will be combined with the dust, and the effect of gravity will drop after condensing, to achieve the purpose of dust suppression. The fog cannon machine is suitable for dust suppression, construction site dust reduction, demolition dust reduction. Applications extend to urban development zones, station coal storage yards, coal washing plants, coking plants, iron mines, steel plants and ports. The main function is spray dust suppression. Fog cannon machines can spray dust particle in the respective areas of concern, with the ability to decompose and desalt the particle concentration in the air and quickly force down the polluting particle and dust floating in the air. The 'science' behind fog cannon dust suppression. The core theory in fog cannon dust suppression is the Slipstream Effect. To bind fugitive dust in the air and bring it to the ground, the dust suppressant droplet and dust particle must be comparable. The dust particle is more likely to collide with the droplet and be absorbed, driving the dust to the ground. Smaller dust suppressant droplets and enough water are the recipe to incredible coverage. Smaller droplets have the potential to travel farther because of the higher of surface area to mass, which means the influence of air pressure compared to gravity is relatively greater. Therefore, the air will keep them buoyant longer before the effect of gravity brings them down. The science is that heavier water droplets are susceptible to gravity more quickly like clouds where when water droplets grow too large, they fall as rain. Smaller droplets can be more prone to evaporation, which is why you need the right nozzle for your situation. In some cases, it might be the desired effect depending on your situation. The tiny, water droplets form a dense fog and trap the dust particles increasing their weight which causes them to fall from the air. The fog cloud also needs to be greater than the concentrations of dust particles in the air so that all the dust can be captured.

The components of a fog cannon dust suppression system

1. **Nozzle:** atomize the water into suitable dust-reducing water mist particles, thereby speeding up the dust-reducing speed and making the spraying more uniform.
2. **Water pump:** The heart of the dust removal fog gun machine, which mainly realizes the delivery of water from the water tank to the nozzle and atomizes the water through high-pressure water flow.
3. **Fan:** produces high-speed airflow. When the fan wheel rotates, the high-speed airflow is ejected from the air outlet to blow the fine droplets formed by the nozzle atomization to the required area.
4. Generally, centrifugal fans with convenient driving, high wind pressure, high wind speed and strong air penetration are adopted. The blades adopt backward curved blades with higher total pressure efficiency, which can ensure the spray range and improve the atomization effect.[2]
5. **Turning and positioning device:** the outlet direction of the air outlet pipe can be rotated 360° in the horizontal plane (generally, it can only be rotated at 350° in actual operation) to adapt to the change of the operating wind direction, and there is another setting in the air outlet pipe. A steering positioning device is used to adjust the elevation angle of the air outlet.

Figure-3: Mist cannon.

The advantages and disadvantages of fog cannon dust suppression: The key criteria to consider benefits of fog cannon dust control would be reduction in volume of water used from the dust suppression system and the elimination of residue. The advantages of using fog cannon dust suppression are mostly application dependent. With fog cannon systems you use water more strategically and achieve lower associated cost. Reduced

storm water effects and runoff, which are critical in keeping air and land pollution in balance. Fewer pools of water to ensure a safer and more efficient worksite. Fog cannon dust suppression avoids product over-saturation, often creating a muck that is difficult to handle and sticks to facility surfaces and equipment, shortening life of both. With fog cannon dust suppression, one achieves reduced labor costs due to automated operation. Plug, play and forget about it! Water flow rates can be adjusted to regulate the volume of water discharged forms the fog cannon to control both surface dust and airborne dust without saturation problems. The cannons can be set up in a fixed or mobile position depending on the site-specific needs. Fog cannon dust suppression contribute to the popularity of wet dust suppression choices. They are highly effective, and implementation is fast and straightforward. Provision of long-term solutions that can provide years of trouble-free performance with regular maintenance. First, they are incapable of significant coverage due to evaporation. They also have limitations in the requirement of a controlled environment. Ideally, an enclosed environment, with no wind movement. The fog must stay in the air, undisturbed and prolonged to be able to slowly bond to dust particles. Finally, when dust particles are hydrophobic in nature, the fog will only act as a barrier, rather than capturing the dust and dropping it from suspension. However, the addition of technologies such as GRT: Activate can greatly improve the function and outcome of fogging systems for dust control.

The applications of a fog cannon dust suppression system: Fog cannon dust suppression systems are designed to tackle the problem of airborne dust particles generated from mining activities, demolition sites and bulk material handling sites. The fog cannon units come in different sizes. The smaller units are ideal for suppressing dust where it is generated in high concentrations at easily defined point sources such as discharging onto stockpiles, discharging into ships, reclaiming from stockpiles, dumping, crushing and loading/unloading trucks. The fog cannon is directed at the point source of the dust, and it rapidly suppresses the emitted dust before it can disperse. The larger units can suppress general airborne dust through fogging the general area. They are also capable of suppressing dust caused by high volume dust events such as blasting, and the low throw distance is usually necessary for this. Fog cannons are also useful for dust suppression of stockpiles where their low water use is an advantage. Throw ranges of fog cannons vary from 30 to 500 meters and they utilize powerful fans. Automatic rotation can be up to 360 degrees with adjustable elevation angles from 0 to 45 degrees. Water consumption varies from 15 liters/min up to 6000 liters/min depending on the model and application. Chemical dust suppressants such as surfactants and liquid polymers can also be added to spray to either make water work or develop a crust on the stockpiles. Other fog cannon system accessories include telescopic elevation systems, remote control including remote camera, intrinsically safe version for explosive atmospheres and self-contained vehicle units.

Figure-4: Spray cannon.

Table-1: Fog cannon specialties.

MODEL	CTFC30	CTFC50	CTFC70	CTFC100	CTFC120	CTFC150
Power [KW]	9 KW	13 KW	30 KW	50 KW	58 KW	75 KW
Minimum flow [m^3/hr]	1.5-2.4	3.0-6.0	4.8-19	8.0-15	12-20	15-24
Throw [metres]	30	50	70	100	120	150
Oscillation [degree]	0-360	0-360	0-360	0-360	0-360	0-360
Throw angle [degree]	-5 to +45	-5 to +45	-5 to +45	-5 to +45	-5 to +45	-5 to +45
Mounting	Skid/Trolley/Trailer/Truck	Skid/Trolley/Trailer/Truck	Skid/Trolley/Trailer/Truck	Skid/Trolley/Trailer/Truck	Skid/Trolley/Trailer/Truck	Skid/Trolley/Trailer/Truck

CTFC: Certificate in Trade Finance Compliance

Dust management: Dust, if not managed effectively, can reduce productivity, have a serious impact on operational costs, damage the environment and cause harm to the safety of workers and surrounding communities. The fog cannon produces a mist from water which effectively suppresses airborne dust particles. Dust kills and binding it at its source helps to save lives. GRT advocates for dust suppression to minimize the risk to miners, workers and communities with the vicinity of dust generating activities.

Features

➢ Unique dual fan system ➢ Horizontal stainless steel water pumps	➢ Droplet size between 5 and 50 microns ➢ Up to 100 nozzles per mist cannon
➢ High power turbine fans	➢ Coverage up to 20,000 m²
➢ Higher pressure water pumps on bigger mist cannons	➢ Strong chassis and body
➢ Throw distance up to 100 m	➢ Radio remote control available (up to 300m)

Benefits

➢ Prevents and reduces dust explosion and fire risks	➢ Protects the health of employees
➢ Prevents potential accidents by improving vision	➢ Wide range of applications
➢ Reduces cleaning, maintenance, and operating costs	➢ Low cost maintenance and servicing
➢ Safe site increases motivation and productivity of employees	➢ Reliable and cost-effective on the market
➢ Continuous compliance with health and safety regulations	➢ Easy to operate

Use Mist Cannons

➢ Dust suppression at work sites	➢ Meet Health and Safety conditions for employees
➢ Create favorable working conditions for employees	➢ Environmental protection

The main application areas for mist cannons

➢ Mining and quarrying sector	➢ Excavation and urban transformation
➢ Crushing and screening plants	➢ Solid waste facilities
➢ Cement plants	➢ Municipalities
➢ Thermal power plants	➢ Dams
➢ Iron steel plants	➢ Tunnels and ports
➢ Construction sector and demolition	➢ Asbestos removal

CONCLUSION

Dust, if not oversaw adequately, can lessen usefulness, genuinely affect operational expenses, dirty the air we inhale and threaten the security of laborers and surrounding areas. Fog cannons are a compelling choice for dust suppression and water dissipation in mines, quarries, building locales, destruction destinations, construction sites, demolition sites and other industrial territories. This is on the grounds that they can be effectively set up, are convenient and are ideal for handling apparent dust. As industry pioneers in dust control, Synergy Spray is focused on conveying the most operationally strong and practical arrangements. Remembered for our supplement of dust control arrangements is a scope of mist guns. A Fog cannon siphons highly compressed water through a progression of fog nozzles, transforming water into fog through atomization. This fine fog is scattered through the air by an incredible fan. At the point when airborne dust particles crash into the fog, dust particles are caught, and along with water because of expanded weight, it returns to the source and doesn't get an opportunity to spread. Synergy Spray's mist cannons can be deliberately positioned close to dust producing sources, for example, tip territories, streets or stacking areas, to accomplish powerful dust suppression. They can be auto actuated by controllers, radar sensors, climate sensors or remote control. The measure of water being utilized by the guns can likewise be completely controlled to enhance water utilization. Mist guns are ordinarily slip mounted or mounted on a trailer for simplicity of portability. They can act naturally fueled through consideration of an in-constructed diesel generator. Synergy Spray supplies cannons in various sizes, with various water release range that can be either fixed or wavering. Numerous fans can be interlinked on bigger locales for simplicity of activity and control.

Biography: Eminent scholar cum researcher **Prof. Dr. Dhrubo Jyoti Sen** [*D.Pharm., B.Sc. (Hons), B.Pharm. (Hons), M.Pharm., Ph.D., FICS, CChem FIC (India), CChem FRSC (UK), CSci (UK), AOM (USA)*] who is at present working as a professor of pharmaceutical & medicinal chemistry in Techno India University, School of Pharmacy, Kolkata, West Bengal, India is working in academic field from more than two decades and has

published more than 560 research/review papers in peer reviewed national/international journals of high impact factor, presented 13 papers in conferences and has authored 175 conference abstracts in national/international conferences and has published 27 books. He is the son of (Late) Prof. Chiranjib Sen, M.Sc. (Chemistry), FIC (India); Principal, Institute of Pharmacy (Bihar Govt.; Health Department), Agamkuan, Gulzarbag, Patna–800 007, Bihar & Mrs. Archana Sen, B.A. He did Diploma in Pharmacy [1988] and became recipient of K.K. Acharjee Award from the Indian Hospital Pharmacists Association, New Delhi due to first rank in Diploma in Pharmacy examination in state of Bihar. He did B.Sc. (Hons) in Chemistry [1987] from Patna University. Later on, he did B.Pharm. (Hons) [1992] M.Pharm.[1994] & Ph.D. [2001] all from Jadavpur University and entered into the academic field [2000 onwards]. He has two patents funded by Research Grant from Royal Society of Chemistry, UK for £2000 [Novel approach of stereospecific substituted 1–[(Z)–1,2–diphenylethenyl]–4–ethylpiperazine moiety by green chemistry synthesis for growth inhibition of falciparum species & Novel synthesis of stereoisomers of substituted cinnamic acid derivatives with amino/thio propanoic acid adducts for inhibiting viral load of HIV genome] for his novel work. Postgraduate research work on M.Pharm. project entitled as Industrial problems in manufacturing of guaiacol from o–anisidine & manufacture of m–nitrobenzaldehyde; a drug intermediate was performed by GATE [1993] scholarship in the laboratory of Medicinal & Pharmaceutical Chemistry under the guidance of Late Prof. (Dr.) Samir Chandra Lahiri in the Department of Pharmaceutical Technology, Jadavpur University, Kolkata–700032. Doctoral research work on Ph.D. project entitled as Investigation on newer anti–inflammatory, sedative–hypnotic & antimicrobial agents was done in the field of synthetic Medicinal & Pharmaceutical Chemistry with State Govt. Research Fellowship under the supervision of Prof. (Dr.) Jayanta Kumar Gupta, Head of the Department of Pharmaceutical Technology, Jadavpur University, Kolkata–700032. Life member of eight professional bodies [Life Member of the Indian Pharmaceutical Association (1995), Life Fellow of the Indian Chemical Society (1995), Life Fellow of the Institution of Chemists (2003) (India), Life Member of the Indian Science Congress Association (2005), Life Member of the Association of Pharmaceutical Teachers of India (2005), Fellow of the Royal Society of Chemistry, UK (FRSC, 2022), Life Member of Research Scholar Hub (2014). Paper setter and examiner of 15 Indian Universities for D.Pharm, B.Pharm, M.Pharm & Ph.D. [Hemchandracharya North Gujarat University, Patan; Jai Narain Vyas University, Jodhpur; Gujarat University, Ahmedabad; Nirma University of Science & Technology, Ahmedabad; Veer Narmad South Gujarat University, Surat; Annamalai University, Annamalainagar; Gujarat Technological University, Ahmedabad; Ganpat University, Kherva; Sumandeep Vidyapeeth Deemed University, Vadodara, Gujarat; Jadavpur University, Calcutta; Maharaja Sayajirao University of Baroda, Vadodara; Sankalchand Patel University, Visnagar; Techno India University, Kolkata; Ambuja Neotia University, Kolkata; JIS University, Agarpada].

He has guided 45 MPharm projects, 44 BPharm projects and guided 3 PhD scholars and at present 6 are working under his esteemed guidance. Prof. Sen has bagged 35 national/international awards. He is the recipient of prestigious Chartered Chemist [CChem; 2005] & Chartered Scientist [CSci; 2012] awards from Royal Society of Chemistry, UK and he is the first person in pharmacy field from India to achieve Chartered Scientist award recommended by Nobel Laureate [Dan Schehtman; Discovered Quasicrystals in 2011]. He has achieved Jewel of India twice [2009 & 2014]. He has bagged enormous accolades [K.K. Acharjee Award (1988), Chartered Chemist Award, India (2005), Chartered Chemist Award, UK (2005), Jewel of India Award (2009), Rashtriya Vidya Saraswati Puraskar (2009), Life Time Achievement Gold Medal Award (2009), Rashtriya Vidya Jyoti Award and Gold Medal (2009), Eminent Educationist Award (2010),

International Gold Star Award (2010), Vidya Ratan Award (2011), Gyan Jyoti Gold Medal Award (2011), Bharat Excellence Award & Gold Medal (2011), India Inspiration Award & Gold Medal (2011), Seva Chakra Puraskar (2011), Chartered Scientist Award, UK (2012), American Order of Merit Honour (2012), Golden Educationist of India Award (2013), NEHS Global Award of Excellence and Gold Medal of Excellence (2013), NEHS Jewel of India Award & NEHS Gold Medal of Excellence (2014), Academician of the Year Award (2015), Outstanding Faculty of the Year Award (2015), Award for Special Achievement in Technology (2015), Distinguished Faculty Award (2016), Fellowship Award by (2018), Distinguished Faculty Award (2018), International Scientist Awards (2020), Iconic Educationist Award (2020), International Educator Award 2020–21, Outstanding Scientist Award (2021), Award for Outstanding Achievement (2021), Award for Incredible Academician of India–21, Best Faculty Award (2022), I2OR National Elite Teacher Award 2022 (2022), Distinguished Scientist Award (2022), Engineering, INSO award (2022), Indian Icon Award (2022), International Innovative Future Award (2022)]. He is pioneer researcher in Green Chemistry synthesis of newer Mannich base & Schiff base derivatives of indan, oxadiazole, pyrazole, piperidinone, thiazolidine, dihydropyrimidine, azetidinone, quinazoline, quinoxaline, imidazole, benzimidazole, benztriazole, pyrazolo-triazine, tetrahydropyrimidine and caffeine derivatives having anti-inflammatory, sedative-hypnotic, antihypertensive, antioxidant, antidiabetic, antimalarial, antiviral, antifungal and antimicrobial property in the same molecule. He is working in synthetic field on molecular latentiation, bioisosterism and repository form of indan derivatives and their intramolecular Mannich base heterocyclic adducts and their pharmacological and toxicological activities. He is in editorial board member of 50 national/international peer reviewed journals. He has achieved several national/international research grants for his research projects. Appointed as a Member of Board of Studies of Hemchandracharya North Gujarat University, Patan for three years (2008–2011). Received £450 as a bursary from 7th International Symposium on Biomolecular Chemistry, UK for registration, accommodation & food for attending and presenting poster on *Repository form of antibacterial agent with NSAID shows delayed action over bactericidal as well as inflammation rather than the parent moiety* at Octagon Center, University of Sheffield, United Kingdom: Sponsored by Royal Society of Chemistry & International Union of Pure and Applied Chemistry, 27 June–1 July 2004. Worked as a Study Director with Dr. Xudong Yuan (Study Director) and Mr. Rutesh Vyas (Scientist) for the joint project *Assessment of anti–obesity and hypolipidemic activity of synthesized compounds in diet induced obesity and hypercholesterolemia mice model after oral administration* at Department of Pharmaceutical Science, AMS College of Pharmacy and Health Science, Long Island University, Brooklyn, New York, USA. Played the role of referee for my M.Pharm. students for getting admission into the AMRSC category of the Royal Society of Chemistry, UK: Mr. Vishal J. Patel (2006), Mr. Amitkumar K. Joshi (2007), Mr. Dipesh A. Chaudhary (2007), Mr. Mehul K. Patel (2008), Mr. Meghal V. Modi (2008), Mr. Krishna A. Patel (2008), Mr. Maulik K. Prajapati (2008), Mr. Dhavalkumar M. Patel (2008), Avani H. Sheth (2010), Yatri R. Shah (2010), Parimal M. Prajapati (2010). Appointed as a judge of the essay competition for the topic Self-medication–how safe? Ask your pharmacist: At the National Pharmacy Week, organized by the Indian Pharmaceutical Association, Mehsana branch, 19–25 November 2006. Received financial assistance of Rs.50800/– under travel grant scheme (air–fare, registration & per–diem) for attending 10th Annual Florida Heterocyclic and Synthetic Conference, USA: 08–11 March 2009 from (AICTE) All India Council for Technical Education, New Delhi in the year 2008. Awarded £2000 as research grant from the Royal Society of Chemistry, UK for the research work Synthesis, characterization and Pharmaceutical screening of quinazoline coumarin fused ring heterocyclic derivatives in the year 2009. Biography included in Marquis Who's Who in the World 2011 (28th Edition) from New Providence, New Jersey, USA. Registered VIP# 35153364. Name included in the list of Leading Educators of the World–2011 by the International Biographical Center, Cambridge, United Kingdom. Name included in the list of Top 100 Educators–2011 by the International Biographical Center, Cambridge, United Kingdom. Received Rs.1400000/– as a Research Grant under Modernization and Removal of Obsolescence Scheme (MODROBS) from AICTE, New Delhi for the year 2011–12. Appointed as a Judge in scientific session of oral/poster session of Colloquium–2020 at JIS University, West Bengal on 11–13 June 2020. Selected in 100 Eminent Academicians of India 2021 book [Vol. 1 December 2021; ISBN: 978–81–950538–6–5; Published By: International Institute of Organized Research (I2OR), India – 2021, Number 3179, Sector 52, Chandigarh (160036) – India]. Appointed as an External Subject Expert of Sankalchand Patel University, Visnagar for PhD program in pharmacy in 2018. Appointed as a Subject Expert of Doctoral Progress Committee (DPC) of Gujarat Technological University, Ahmedabad for PhD program in pharmacy in 2018. Appointed as a Subject Expert of Research Advisory Committee (RAC) of The Neotia University, Kolkata PhD program in pharmacy in 2020. Worked as DPC member for PhD topic of Chirag Gohil [2016–2020]: *Design and*

Synthesis of MDM2 Inhibitors to Reactivate p53 Function. Guided by Dr. Malleshappa Noolvi [Professor and Principal, Shree Dhanvantary Pharmacy College, Kim (E), Dist.: Surat 394 110, Gujarat, India]. Life Member of the Indian Pharmaceutical Association, Fellow of the Indian Chemical Society, Life Fellow of the Institution of Chemists (India), Life Member of the Indian Science Congress Association, Life Member of the Association of Pharmaceutical Teachers of India, Fellow of the Royal Society of Chemistry, UK, Life Member of Research Scholar Hub. Paper setter of Pharmaceutical/Medicinal Chemistry [DPharm, BPharm, MPharm & PhD] and examiner of 15 Indian Universities [Hemchandracharya North Gujarat University, Patan; Jai Narain Vyas University, Jodhpur; Gujarat University, Ahmedabad; Gujarat University, Ahmedabad; Nirma University of Science & Technology, Ahmedabad; Veer Narmad South Gujarat University, Surat; Annamalai University, Annamalainagar; Gujarat Technological University, Ahmedabad; Ganpat University, Kherva; Sumandeep Vidyapeeth Deemed University, Vadodara, Gujarat; Jadavpur University, Kolkata; Maharaja Sayajirao University of Baroda, Vadodara; Sankalchand Patel University, Visnagar; Techno India University, Kolkata; Ambuja Neotia University, Kolkata; JIS University, Agarpada]. Attended 80 symposiums, 18 workshops, 10 Faculty Development Programs. Delivered a Special Guest Lecture on the topic Organometallic agents: A diversion towards chemotherapeutic agents as well as pharmaceutical aids held at the Department of Pharmaceutical Engineering & Technology, School of Engineering & Technology, Bharathidasan University: [Accredited Grade–A from NAAC], Tiruchirappalli, Tamilnadu, on 10 March 2005 which has been highly appreciated by the audience. Delivered a Guest Lecture on Reflection of green chemistry in protection of environment in AICTE Sponsored Quality Improvement Programme on Glimpses of current advances in the field of pharmaceutical sciences held at M.S. University of Baroda, Vadodara, Gujarat on 8 June 2010. Delivered a Guest Lecture as a resource person on one day national e–conference on Immunomodulator Neutraceuticals and its Quality Control for the topic *Journey of good health starts from micronutrients and end at macronutrients* at Laxminarayandev College of Pharmacy, Bharuch, Gujarat on 31 July 2021.

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