Innovative Waterless Dust Collection Technology for Mining and Mineral Industry

Dr. P Sharath Kumar
Chairman,
Dept. of Mineral Processing ,

National Mining Conclave 2024

Table of contents

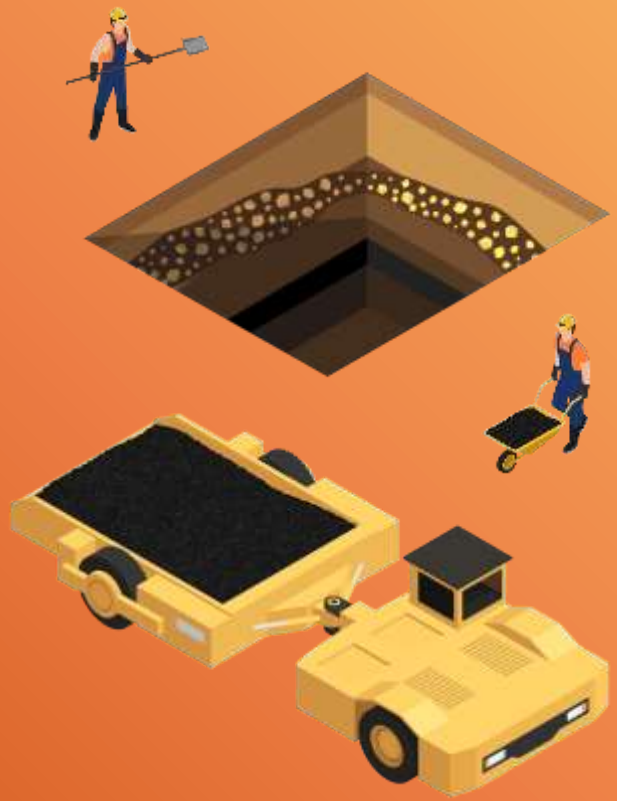
Introduction !

- Opencast mines contribute more to air pollution than underground mines.
- opencast mining activities results in widespread air-quality degradation due to dust and gaseous pollutants generated in and around the mining facilities.
- It is necessary to control dust that is getting generated from mining operations since it is vital to maintaining a pollution free environment in the areas near to the mines

- Dust suppression is referred to as the prevention of particles from being air borne
- This is accomplished by making use of **water sprinklers, foggers or foam generation systems.**

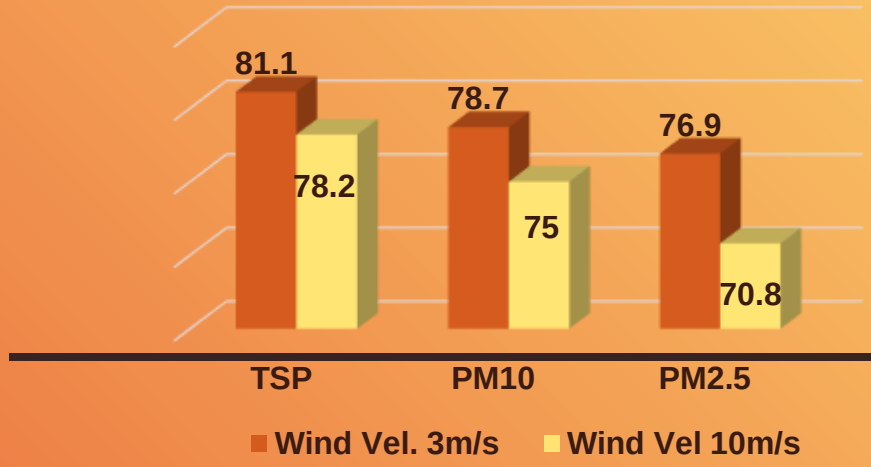
- The most common, way of controlling fugitive dust **is sprinkling of water** on the
  stock,
  haul roads
  railway sidings.

Dust Suppression Efficiency using Water Mist Technology

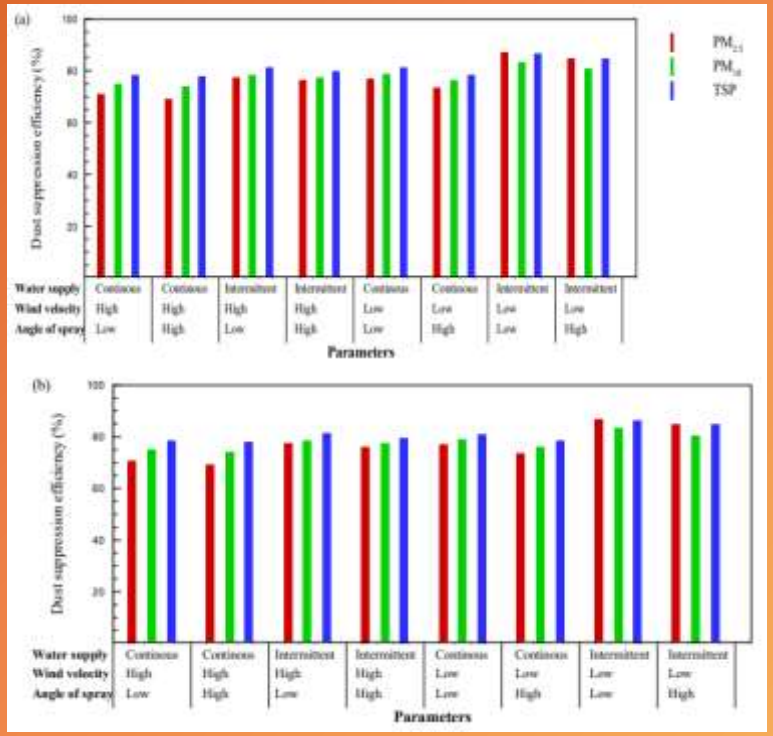


Water mist/droplets were atomized intermittently or continuously using either the mist generating machines or the sprinklers at different angles with different wind velocities to reduce the dust

The water mist technology, under continuous water supply at **high wind velocity of 10 m s–1** , and **low wind velocity of 3 m s–1 are shown below**



Supression Efficiency



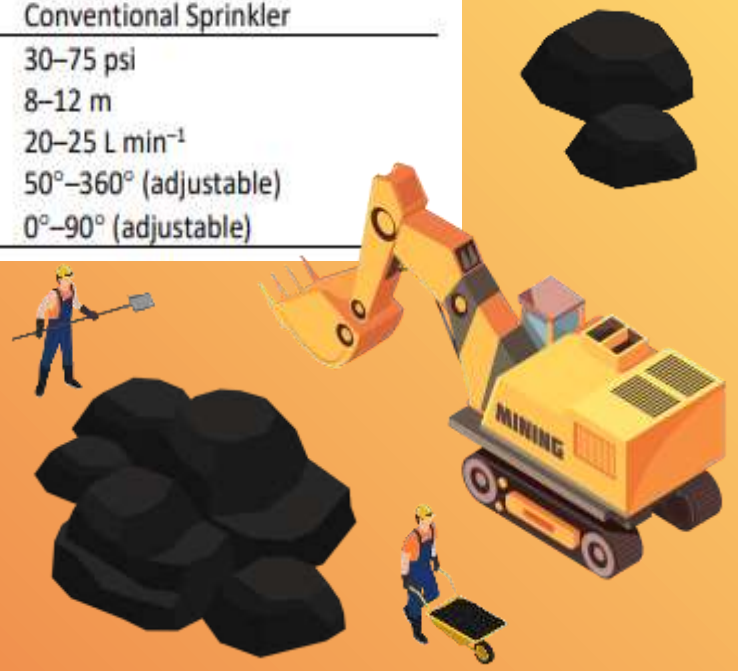
Mist Generators

Conventional Sprinklers

Source : https://doi.org/10.4209/aaqr.210320

Mist Generators Vs Sprinklers

Specifications of the Equipment	Mist Generation Machine	Conventional Sprinkler
Pressure	290–1450 psi	30–75 psi
Spray radius	50 m	8–12 m
Spray water	150 L min^{-1}	20–25 L min^{-1}
Rotation angle	0°–179°	50°–360° (adjustable)
Spray elevation	–10°–90°	0°–90° (adjustable)



Dust suppression through mist and sprinkler technology is mostly affected by two key factors.

The efficiency of droplet-particle interaction in the gaseous phase

The physicochemical interactions succeeding the droplet-particle contact.

Concepts

To enhance the dust suppression efficiencies,

selected wetting agents are applied which are mostly

fatty alcohols including sodium hydroxide,
urea,
calcium chloride,
ethyl alcohol,
sodium chloride and water.

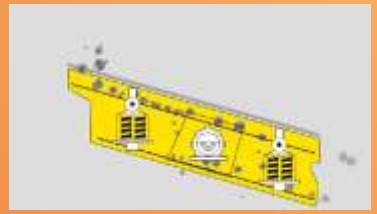
Most wetting agents have drawbacks such as unsanitary and unhygienic properties, strong corrosive effects on equipment, complex preparation methods, high cost

Dust Supression

The impact of mining and mining related activities on the environment in the form of air pollution also depends on numerous meteorological conditions, such as wind speed, wind direction, temperature, amount of rainfall, atmospheric stability, etc.

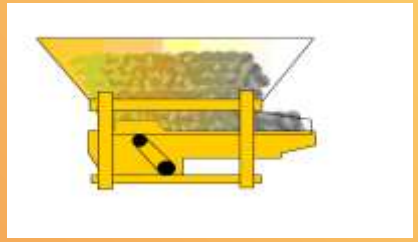
Crushing

The size, shape, and composition of dust particles vary, affecting how easily they can be controlled. Finer particles are more difficult to capture and suppress.



Screenng

Screening of Dry stock generates fugitive dust, and water spraying will alter the efficiency of screening



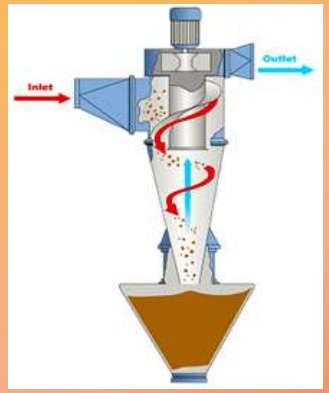
Feeding

Feeders , allow the coarser particle to shatter and generate the dust

Existing Available Technologies:

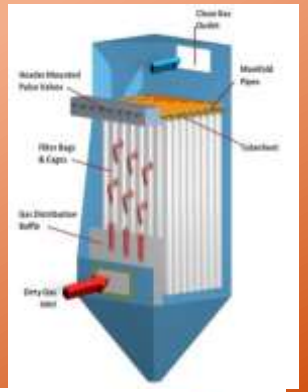
Cyclones

Lower efficiency



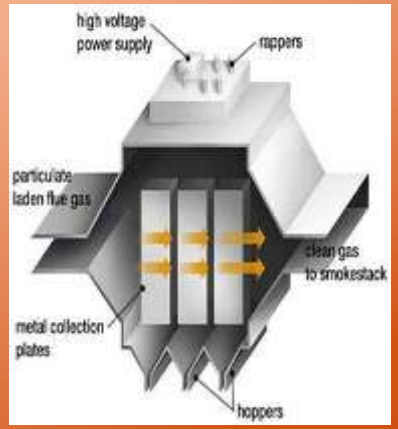
Bag filters

High Operational Cost



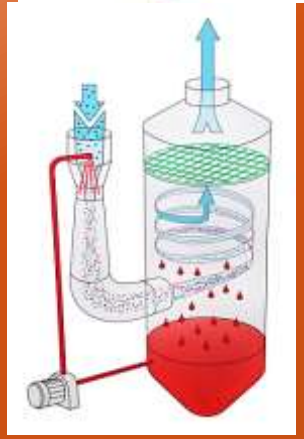
ESPs

High investment cost

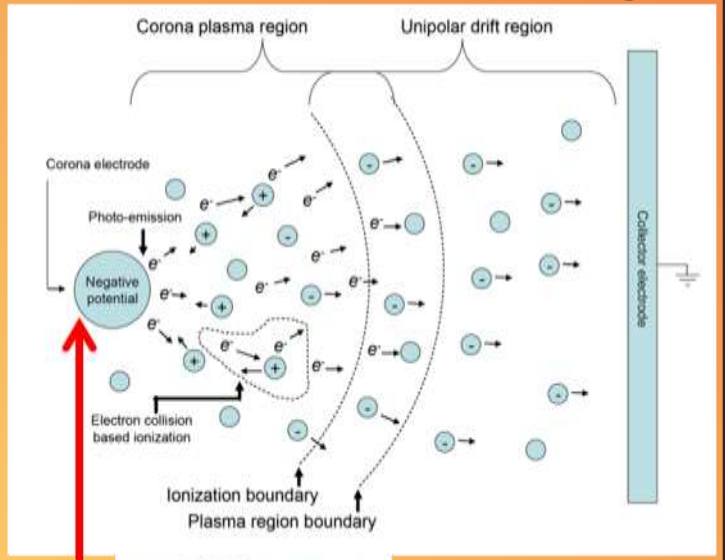


Scrubbers

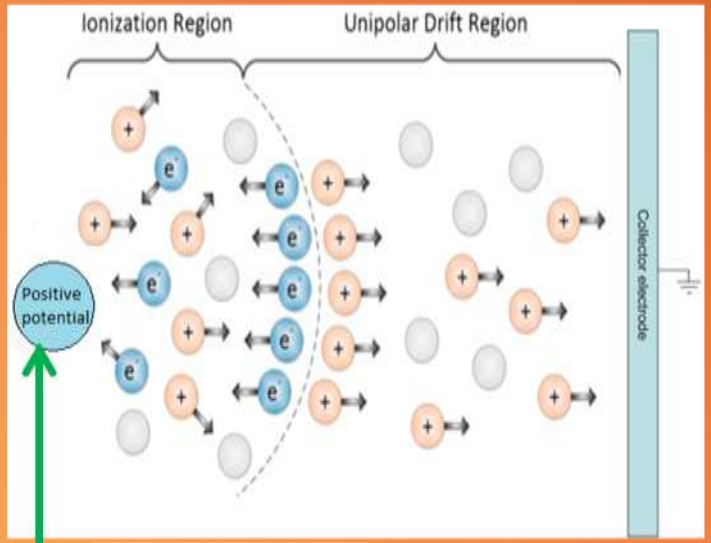
Water sludge generation



Bipolar Electrostatic Cyclone System



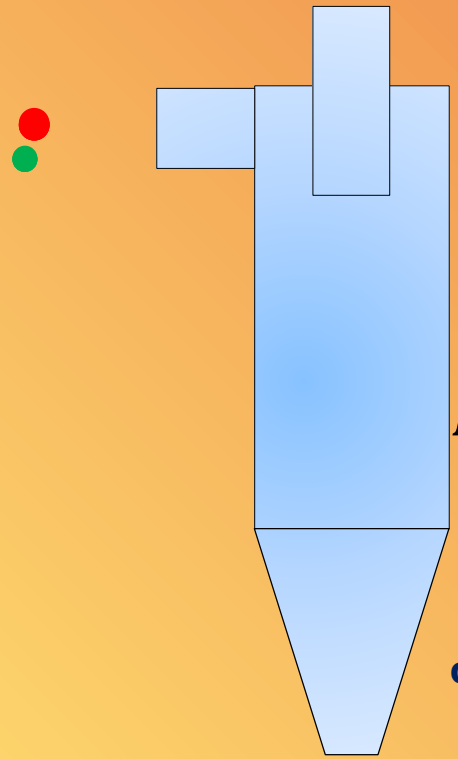
Negative Discharge Corona



Positive Discharge Corona

Confidential

Animation : Particle flow



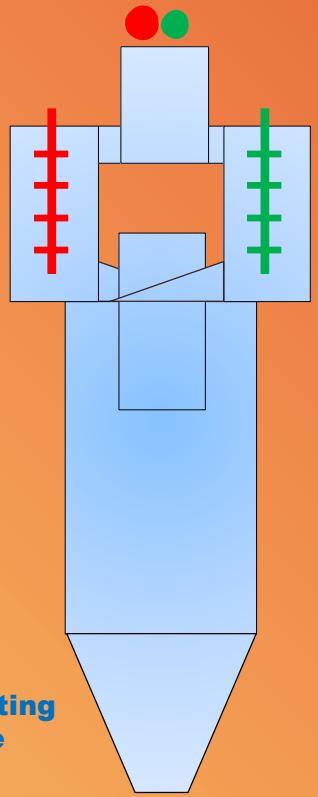
Bigger particle

Smaller particle

Performance of Cyclone

$$F_c = \frac{d^3 \quad V^2}{r}$$

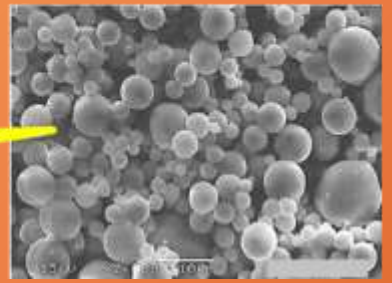
Conventional Cyclone



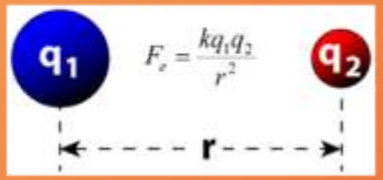
Agglomerating Cyclone

Without Particle Charging

With Particle Charging

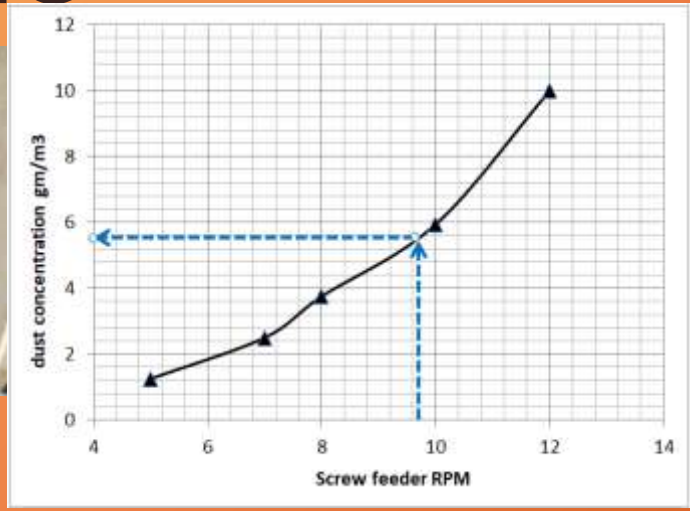


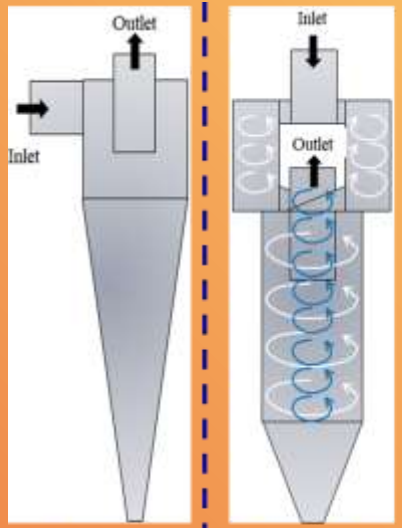
Electrostatic Force of Attraction of particles

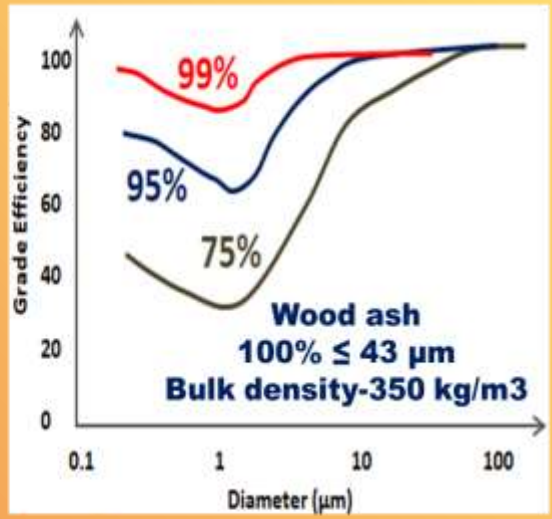


$$F \leq 6 \times 10^{-7} N$$

Dust Loading Lab Scale



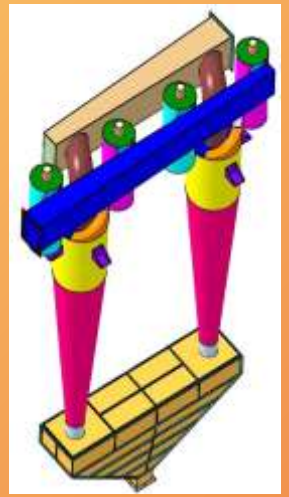




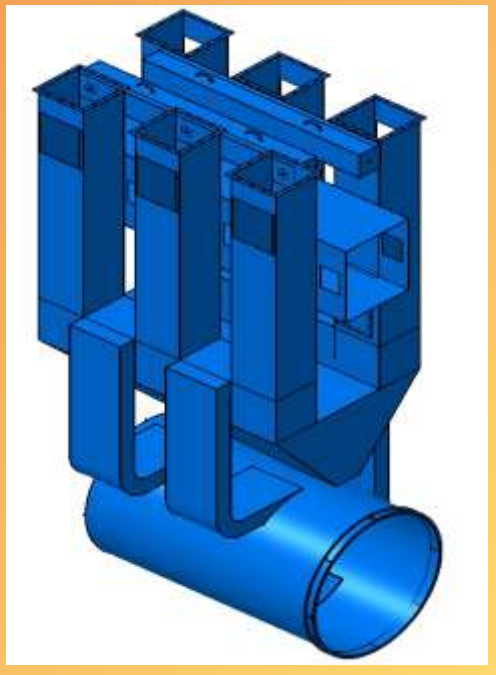
Cyclone **Cyclone-S** **Cyclone-ES**

75% **95%** **99%**

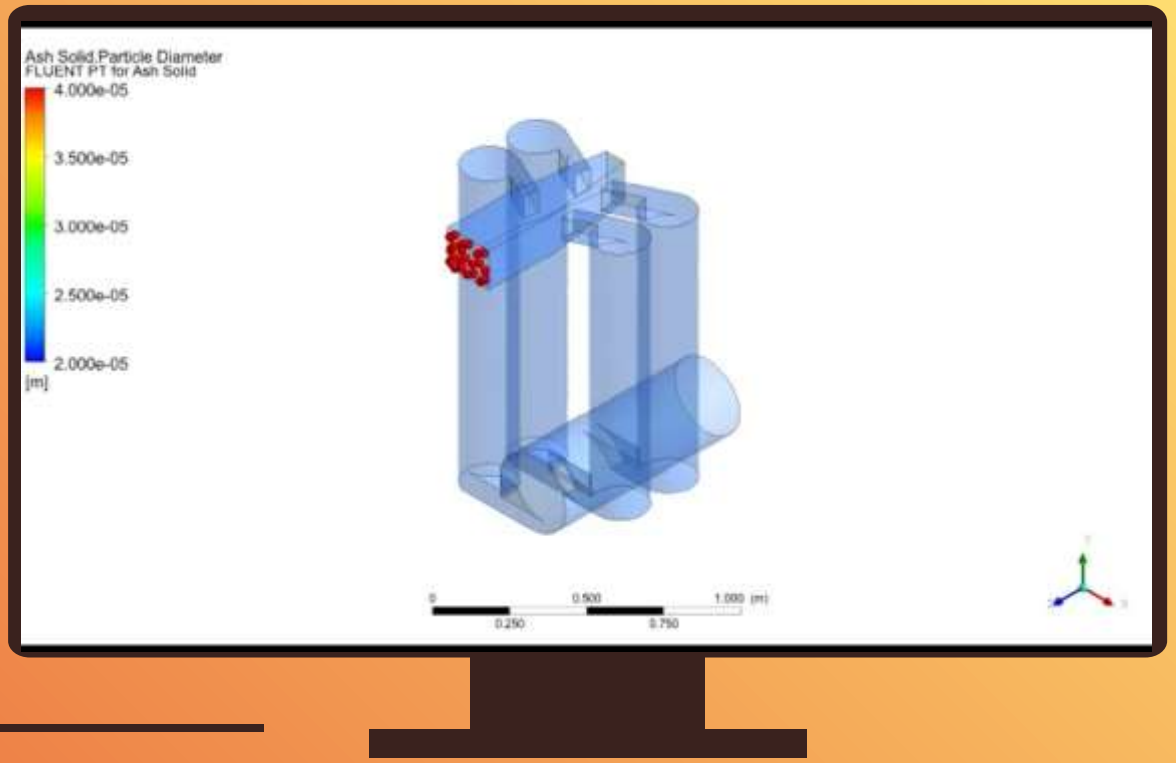
Collection Efficiency



Designs for specific Applications



Computer Simulation



Our team

Dr Sharath Kumar
Chairman, Dept of Mineral Processing, VSKU PG Centre Nandihalli-Sandur

Surendra Kumar
Propriter, Enviation Technologies Llp, Koppal

Santhosh Kumar
Co-Founder, Enviation Technologies Llp, Koppal

Thanks!

Do you have any questions?

sharathkumar@vskub.ac.in
+91 9481032365
www.enviation.com

Aacknowledgment:

We sincerely acknowledge the encouragement and support from MSAK and MEAI