Abstract:
Rich in metal oxides, fly ash has tremendous potential to be utilized as a coating material on structural and engineering components. Fly ash is basically solid waste generated in huge quantities from coal fired thermal power stations during the combustion of coal. This work aims at developing and characterizing a new class of such coatings made of fly ash by a novel technique like plasma spraying. Plasma spray technology has the advantage of being able to process various low-grade-ore minerals to obtain value added products and also to deposit ceramics, metals and a combination of these, generating near-homogenous coatings with the desired micro structure on a range of substrates.

Introduction:
Fly ash is one of the residues generated in the combustion of coal. It is mostly captured from the chimneys of coal power plants. The components of fly ash composed vary appreciably, depending upon the source and makeup of the coal being burned. But all fly ash includes bounteous amounts of silicon dioxide (SiO$_2$) and calcium oxide (CaO). Fly ash is a fine, glass powder recovered from the gasses of blazing coal throughout the processing of power. These micron-sized earth components comprise fundamentally of silica, alumina and iron. Fly ash particles are just about completely round fit as a fiddle, permitting them to stream and mix uninhibitedly in mixtures.

Thermal power generation is around 73% of the nation's aggregate power generation, of which coal-based is 90%. Around 85 thermal power stations, furthermore a few captive power plants use bituminous and sub-bituminous coal and supply plentiful amounts of fly ash.

Mild Steel also known as Low Carbon Steel is most common form of steel with 0.30% carbon content. It is ductile can be easily machined, relative cheapness of production, ease of cold working. Mild Steel is the most commonly used engineering material and finds extensive day to day application.

Objectives:
Fly ash is one of the residues generated in the combustion of coal. It is mostly captured from the chimneys of coal power plants. The components of fly ash composed vary appreciably, depending upon the source and makeup of the coal being burned. But all fly ash includes bounteous amounts of silicon dioxide (SiO2) and calcium oxide (CaO). Fly ash is a fine, glass powder recovered from the gasses of blazing coal throughout the processing of power. These micron-sized earth components comprise fundamentally of silica, alumina and iron. Fly ash
particles are just about completely round fit as a fiddle, permitting them to stream and mix uninhibitedly in mixtures.

Keeping the goals of protecting the environment, increased importance has been placed on developing recycling techniques for industrial waste products. Disposal of flyash - an industrial waste and by product of thermal power plant - is an issue of great importance. This industrial waste presents serious problems of storing and environmental pollution by posing a serious threat to health. The effective utilization of waste fly ash not only decreases environmental pollution, but also produces high value-added products. It has been reported by many researchers that flyash exhibits superior mechanical and physical properties; however, a limited work has been carried out to employ flyash as protective coating material. If successfully sprayed on engineering components, fly ash can be a cost effective substitute for conventional extenders in high performance industrial coatings. It can be utilized to develop coatings on metal substrate as it posses excellent wear and corrosion resistance.

Mild steel material offers excellent strength to cost ratio making them attractive for many day to day applications. Engineering components and structures are increasingly being constructed from mild steel owing to combination of low cost, easily available and easily machinable. However, mild steel exhibits poor wear and corrosion resistance. It can easily rust under normal environmental conditions which can lead to reduced performance and can eventually lead to catastrophic failure of components.

Currently, development of effective anti-wear and corrosion coatings for mild steel is an issue of great importance for durability of structures and components made of mild steel.

In the light of the above the objectives of present investigation are,

1. To develop plasma sprayed flyash (industrial waste) coatings on mild steel substrate.
2. To characterize microstructure and microhardness of developed flyash coatings.
3. To evaluate the slurry erosive wear and corrosion resistance of the developed coatings.
4. To compare slurry erosive wear and corrosion performance of uncoated and plasma sprayed flyash coatings.

**Methodology:**

Mild steel substrates of 10-20mm thickness will be subjected to thorough milling and grinding to obtain dimensional equilibrium followed by cleaning using acetone. Machined substrates will be subjected to shot grit blasting to attain proper roughness of the surface. Coating trials will be carried out using plasma spray coating system under various process conditions. Flyash of particles size in the range of 100-150 microns will be used as spray powders / coating material. To attain uniform coating characteristics such as current density, powder feed rate and standoff distances will be optimized considering hardness and porosity as quality characteristics. Prior to coating, Sand blasted mild steel substrate will be bond coated. A bond coat thickness of 30 µm was maintained. Coating trails will be carried out according to design of experiments.

The developed coatings will be subjected to optical microstructure studies and scanning electron microscope. X-Ray diffraction studies will be carried out to identify the phases of feed stock powder found in the developed coatings. Micro hardness of the developed coatings will be evaluated using microhardness tester under a 100 grams load for 10 sec on both coated and uncoated substrate samples. Friction and wear test will be carried on coated and uncoated samples. ASTM g 99 standard test method will be adopted. After the test, specimens will be dried and cleaned before measuring weight loss. Further, developed coatings will be subjected to salt spray test studies as per ASTM B117 standard test method.
**Expected Outcome:**

1. Industrial waste (Fly ash) can be profitably converted into Defensive coatings.
2. Plasma spray coating of fly ash on mild steel can be a prospective candidate material for protection of mild steel components.
3. Useful in converting toxic waste material into greener and protective material.
4. Improves the performance and lowers the cost and life of mild steel components in industries.
5. Utilization of flyash as coating material helps to reduce the cost of waste disposal.
6. Provide a potentially cheap substitute to existing costly feedstock/coating powders.