Cyclic Corrosion and Oxidation of Inconel-600 in Molten Salty Environment at 800^{0}C by D-Gun Sprayed Coating

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Abstract: ***Deterioration is the main cause of failure in Metals and alloys due to high temperature oxidation in the boiler, gas turbine, and other power generating units. Alloys are employed due to higher mechanical properties and creep resistance for air and salty environment. In current studies, Al_2O_3 - 40%TiO_2 coating has been sprayed on Inconel-600 alloys at 800^{o}C by Detonation Gun (D-Gun) sprayed technique. The elevated temperature oxidation behavior of uncoated and coated alloy has been estimated by exposing the specimens at 800^{o}C for 50 cycles of 60 Minuets heating followed by 20 minutes cooling in each cycle at ambient condition. At temperature below 650^{o}C corrosion attack is relatively insignificant and significant above the750^{o}C since contaminants are in the solid phase. The oxidation kinetics and hot corrosion kinetics of coated and uncoated alloys have been fixed with the help of weight change measurements. The D-Gun sprayed coating has shown good contaminants to the substrate metal and lower weight gain in coated sample as compared to bare alloy Inconel-600. The oxidation behavior of Inconel-600 in salt of 50% Na_2SO_4 + 50%NaCl has been studied under isothermal conditions at a temperature of 800°C in a cyclic manner. Squalor of components of boilers, gas turbine, metallurgical furnaces, petrochemical installations are mainly due to the high temperature oxidation and hot corrosion. Superalloys find their wide applications in the gas turbine and marine engineering due to their good mechanical properties at elevated temperature. It was observed that all the coated and uncoated Inconel mapping techniques were used to analyze the oxidation products of the coated and uncoated Inconel. The uncoated Inconel and hot corrosion in the form of its oxide scale, which was perhaps due to the formation of unproductive oxide scale. The coating showed better resistance to the air oxidation as compared tothe uncoated Inconel. The coating Al_2O_3 - 40%TiO_2 was found to be more protective. The formation of oxides and spinals of aluminum and titanium may be contributing to the development of air oxidation resistance in the coatings. The high temperature oxidation and hot corrosion behavior of Al_2O_3 - 40%TiO_2 coatings on inconel-600 has been investigated at 800^{o}C in air and molten salt 50% Na_2SO_4+ 50% NaCl under cyclic heating and cooling conditions for 50 cycles. The kinetics of oxidation of coated and bare boiler steel has been established with the help of weight change measurements. The kinetics of oxidation may be define by evaluation by parabolic rate constant value K_P, which was found by the following rate equation: $(\Delta W/A)2/t = K_P$ where $(\Delta W/A)$ was the weight change measurement per unit surface area and Kp the parabolic oxidation rate constant, t the cooling time. It was observed that all the coated and bare steels obeyed parabolic rate law of oxidation (K_P). The oxidation and hot corrosion of the coated and uncoated Inconel. The uncoated Inconel-600 are hot corrosion in the form of intense spelling and peeling of its oxide scale, which was perhaps due to the formation of unproductive oxide scale. The coatings showed better resistance to the air oxidation as compared to the uncoated Inconel-600. The Al_2O_3 - 40%TiO_2 coating was found to be more protective. The formation of oxides and spinals of nickel and chromium may be contributing to the development of air oxidation resistance in the coating***

Keywords: Deterioration of metal and alloys, preventing of metals from hot corrosion, detonation spray coating of metal,D-spray

1. Introduction

Corrosion is the decaying of the material or its properties due to the reaction with its environment. Sometimes, the deterioration is an increase in weight, sometimes a reduction in weight, sometimes the mechanical properties are affected. The SPE (solid particles erosion) is a serious problem for the production of electricity, which costs around US $ 150 million per year in yield losses, forced interruptions and repair costs. Alloys and metals sometimes occurrence quicken oxidation when their surfaces are over grown with a thin film of molten salt in an atmosphere of oxidizing gas at elevated temperatures. When sulphides in the substrate and an unprotected porous oxide layer forms on the surfaces is known as hot corrosion. Alloys that develop to resist heat and oxidation generally form a protective layer of chromium oxide or alumina. The faster this layer is established, the better the protection offered. As this layer develops or re-forms in the areas from which the original layer was removed, it must remove chromium or aluminum from the metal to allow for further growth. Super alloys has been developed to improve its resistance to oxidation using the concept of selective oxidation that is influenced by the composition of the alloy, the state of the surface, the gaseous environment and the cracking behavior of the alloy oxide.

The wear of components in boilers, gas turbines, petrochemical plants and metallurgical furnaces is mainly due to high temperature oxidation and hot corrosion. Superalloys finds its main applications in the gas turbine industry due to its good mechanical properties at high temperatures. The oxide scale consists of a stratified structure with variations in the composition and microstructure of the substrate at the external interface. The residual fuel used in the power generation system contains vanadium, sodium and sulphur as impurities. During combustion, sodium and sulfur react with each other and form Na2SO4. Vanadium reacts with oxygen to form V2O5. These dross react to form complex compounds of low melting point, called ashes, which are deposited on the surface of the materials and cause accelerated oxidation corrosion. Corrosion take place when oxide layers that are naturally formed in the materials during the operation of the boiler / gas turbine because of high temperature oxidation. The inability to completely prevent or at least detect hot corrosion at an early stage has resulted in the destruction of engines / infrastructure.

According to Stott, when a clean component is exposed to an oxygen-rich gas, small cores of all the thermodynamically stable oxides grow on the surface and quickly collapse to give a full layer at which time of the initial or transient phase. To achieve greater efficiency, it is necessary that the developed superalloy has a superior resistance to oxidation at high temperatures, since it is harmful at high temperatures. It reduces the valuable life of the superalérgicos components forming oxides to greater speed, reducing the capacity of load and potentially causing a catastrophic failure of the component. It is comprehended that the higher capacity of temperature of the superalloys depends on their chemistry, such as the behave of the alloying elements and the concentration of every alloying element. The main change is the addition iridium of and rhenium or ruthenium at the expense of chromium, which are referred to as third, fourth or fifth generation superalloys, respectively. As a result, the chemistry of an advanced third-generation super alloy was extremely influenced by the reduction in the chromium content (Cr) and the increase in the content of rhenium (Re). Similarly, the 4th and 5th generation super alloys include only about 3% Cr, but rather contain about 6% Re, 1.5% ruthenium (Ru) and / or iridium (Ir), which contrasts sharply with super alloys of the previous generation containing approximately 10% Cr and not Re, Ru or Ir. These are unique elements that can significantly increase the high temperature creep properties, but make the superalloys delicate to corrosion to high temperature, that is, high temperature oxidation and hot corrosion. This is as an outcome of the new superalloys cannot form alumina or chromium flake resistant to corrosion due to the presence of a high content of rhenium and small quantity of iridium and ruthenium. Its consequences is similar to Mo in oxidation that is because of the high vapor pressure of its oxide. As a result, the new alloying elements are detrimental to the high temperature corrosion resistance of latest Ni-based super alloys. Several faults of the blade of the gas turbine engine have been reported in the service. Newer materials with improved properties are necessary to improve the efficiency of gas turbine engines. Efforts in this direction have led to the evolvement of a new superalloy for aircraft engines. The developed super alloy has excellent properties of resistance to high temperature. It has been attributed mainly to high temperature corrosion of various types and has established its relevant theories. A considerale work has been bring along in the laboratory on the hot corrosion of superalloys and several established their distracting mechanisms. It has been display that hot corrosion of super alloys is due to electrochemical reactions and is an electrochemical phenomenon [11]. In addition, high-performance protective coatings have been successfully recognized for the protection of super alloys during hot corrosion conditions. The efforts of other researchers to invent protective coatings have helped to understand their behavior.

Basically, corrosion at high temperature can be classified into hot corrosion and oxidation. Hot corrosion can be classified into type I (600 ° C - 750 ° C) and type II (800 ° C - 950 ° C). As mentioned above, the newly superalloy material that is exploited for gas turbine engine applications must have excellent corrosion resistance at high temperatures, in addition to excellent mechanical properties. Super alloys are broadly used in gas turbines, in particular for the manufacture of hot section components to provide excellent creep resistance and strength in a high temperature condition. During operation, the blades and blades of the gas turbines are associated with severe thermal cycles and mechanical loads. In addition, they have also chemically etched both by hot corrosion and by high temperature oxidation. It is desperate to impart high temperature resistance and oxidation resistance at high temperatures to superalloys simultaneously with ease of manufacture. Only composite materials can satisfy these requisite, the base material that provides the appropriate mechanical strength and the protective coating against wear, erosion, corrosion and oxidation. From commercially available detonation spray (DS), HVOF spray (High Velocity Oxy Fuel) and thermal spray coating method are the best preference for hard, wear resistant and dense coatings. The aim of the study was to understand the role of spray coating with detonation gun to enhance the properties of the substrate surface to counteract problems such as erosion, residual stress, fatigue, friction, corrosion and thermal behavior of an increasingly sophisticated surface technology. The various purpose of the coating, like resistance to wear and corrosion, thermal or electrical insulation, can be obtained through the use of various coating method and different coating materials. Many thermal spray coating deposition method are available and the choice of the best method depends on the operative requirements, the adjustability of the coating material of the technique used, the level of adhesion essential (size, shape and metallurgical structure of the substrate) the handiness and cost of the equipment. The thermal spray processes that have been considered for depositing coatings are listed below:

(1) Spraying the flame with powder or wire, (2) Wire Arc Flash Projection, (3) Plasma Spraying, (4) Spraying and Fuse (5) Spray Oxi-Fuel (HVOF), (6) Blasting gun. The oxidation behavior of metallic coatings of Ni-20Cr using a high speed oxy-fuel (HVOF) and the air plasma spraying process in the steel 9Cr-1Mo substrate has been look at in the temperature range of 600-750^{0}C. The kinetics of hot corrosion as the protective oxide forming Al2O3 + 40% TiO2, the diffusion of the nickel coatings to the substrate and diffusion of substrate iron coatings for a longer exposure to the oxidation to the steam were studied. The tendency towards the creation of the expansion with time and temperature was also investigated at the interface between the substrate and the coating in the APS coating.

This article aims to put up to the knowledge of the oxidation characterstic of the Inconel-600 in an atmosphere of 50% Na2SO4 + 50% of molten salt NaCl in cyclically isothermal conditions. In this experimental study, attention is also focused on oxide flakes that have separated and fallen into boilers during oxidation

2. Hot Corrosion & Oxidation

Hot corrosion can occur at elevated temperatures, where the reservoir is in the liquid state from the beginning, or the solid reservoir becomes liquid during exposure after a reaction with the environment. TypeI and TypeII of hot corrosion processes are referred to as high temperature heat corrosion (HTHC) or heat corrosion type I and low temperature (LTHC) or type II, respectively. Hot corrosion was acknoeledged as a serious problem in the 1940s in relation to the degradation of coal-fired boiler tubes in coal power plants, gas turbines, internal combustion engines, FBC (Fluidized bed combustion) and industrial incinerators. . Hot corrosion is considered a major failure mode for the high temperature components of many important engineering systems, such as aircraft and gas turbines on the ground. Rapp and Zhang (1994) defined hot corrosion as the accelerated oxidation of materials, appearance of a thin layer of molten salt deposition at high temperatures. In hot corrosion, alloys and metals are degrades at higher rates than in gaseous oxidation, sulfides in the substrate, with a porous and non-protective oxide layer formed on the surface. The kinetics of the oxidation process as well as the characteristics of the oxidation products depend strongly on the oxygen partial pressure of the aggressive environment. Hot corrosion in metallic coatings can be classified as Type I and Type II. The temperature range and the damage to the coatings. Type I heat corrosion occurs above a certain temperature (800-950 ° C) when the harmful salts (for example, sulfates such as Na2SO4, K2SO4) melt to dissolve the oxide scale. This process generally produces a porous oxide layer and the underlying alloy / coating with a sulphidation attack. At a lower temperature (600-800 ° C), a bite attack with minimal sulfidation is generally encountered, leading to Type II hot corrosion. The damage caused by hot corrosion depends on many factors, such as the composition of the coating, the thermo mechanical conditions, the composition of the contaminant, the flow rate, the temperature, the corrosion time, the composition and the velocity of the gas and the erosion. Some corrosive salts, oxides and eutectics with their melting points are shown in Table 1; Note that the eutectics of some salts have a lower melting point than the individual salts. Oxidation is a type of corrosion that involves the reaction between a metal and air or oxygen at high temperature in the absence of water or an aqueous phase. It is also called dry corrosion. The oxidation rate of a metal influenced by the nature of the oxide layer that forms on the surface of the metal at high temperature. Alloys and Metals can account accelerated oxidation when their surfaces are coated with a thin film of molten salt in an oxidizing gas. This mode of action is called hot corrosion. Hot corrosion was recognized for the first time as a serious problem in the 1940s in relation to the degradation of boiler tubes by fire in a steam coal plant. Since then, the problem has been observed in boilers, gas turbines, internal combustion engines, industrial waste incinerators and fluidized bed combustion. But hot corrosion has become an important topic of interest in the late 1960s, as gas turbine engines for military aircraft suffered severe corrosion at the time of Vietnam conflict during the operation of seawater. Metallographic inspection of the defective parts often showed nickel and chromium sulfide, so that the mechanism was originally called "sulphuration". However, studies Goebel and Pettit and Bornstein and DeCrescente demonstrated that the formation of sulfur resulting from the reaction of the metallic substrate with a thin layer of molten salt of sodium sulfate to the base, the phenomenon was renamed "hot corrosion”. Therefore, hot corrosion can be explained as an accelerated corrosion due to the the presence of contaminants such as Na_2SO_4 salt, NaCl and V_2O_5 that react to form melt deposits, which damage surface protective oxides.

2.1 Mechanism

1) Oxidation occurs on the surface of the metal that forms the metal ions M2 +
$M \rightarrow M2 + + 2e-$
2) Oxygen is transformed in to oxide ion (O^{2-}) because of the transfer of electrons from the metal.
$n / 2\ O_2 + 2n\ e^- \rightarrow n\ O^{2-}$
3) The overall reaction of the oxide ion reacts with the metal ions to form a metal oxide film.
$2\ M + n / 2\ O_2 \rightarrow 2\ Mn + + nO^{2-}$

The behavior of the oxide formed plays an important role in the oxidation corrosion process.
Oxygen + Metal → Metal oxide (corrosion product)

The oxide formed separates the metal from the gas and the only oxidation path that must be covered is the diffusion of the solid state that can only take place because appearance of a defect in the reactants. This type of diffusion can causes due to the presence of defects in the structure of the oxide. Punctual defects, such as interstitial atoms and misplaced atoms, are necessary for the diffusion of the solid state in the oxide. The growth in scale occurs through the diffusion of the cat ion and the anions. The diffusion of cat ions causes the formation of oxide at the gas-oxide interface and the anionic diffusion leads to the growth of oxide at the metal oxide interface as shown in the figure. The oxide may show non-stoichiometric and mainly contains defects or contains mainly oxygen defects.

2.2. Coating

A major challenge in technological development is to get the demands of new materials in increasingly severe conditions. In general, one or more properties of the materials are incompatible with the conditions prevailing in the operating environment. In the configuration of the hardware environment, the surface of a component is a key parameter to determine its optimal performance. It is the basis for the development of coating technology. It is not possible for a single material to have different properties to satisfy the demand of the current industry. Therefore, a system composed of a base material that provides the necessary mechanical strength with a surface protective layer and / or different chemical composition structure can be an optimal choice to combine the properties of the materials. During the last two decades, the need for protective coatings has increased significantly in the hot parts of gas turbine engines and other internal combustion engines used in non-flight related applications. The problems of high temperature corrosion become much more important for these alloys with the increasing operating temperatures of modern combustion engines. This has led to greater care to given the development of coatings that can give significant compositional flexibility. The purpose of coating is to operate as a solid state diffusion barrier between the effective oxygen (or other gas) and the base alloy. The coating must have a combination that reacts with the environment to produce a protective oxide flake that must not react with the corrosive medium and at the same time must not permits the corrosive particles to diffuse into the coating. Consequently, the identification / development of suitable alloys and coatings is of great interest for such applications. The structures and compositions of the coatings are calculated by the role they must play in the different material systems and performance environments. Materials consisting of alloys of metals and mixtures of metal and ceramics are used, forming specially developed composite systems for predetermined mechanical and physicochemical properties.The materials used as coatings must provide effective protection against oxidation, as well as high thermal conductivity (heat exchangers) to ensure good maintenance and efficient and economical maintenance. The main purpose of the coating is the ability to produce a stable slow-growing surface oxide that forms a barrier between the coated alloy and the environment. An important feature of a solid protective coating is its high chemical hardness and inertness. Conventional methods such as cementation, nitration and electroplating have been used for more than a century to protect tools; However, the development of hard protective coatings in the strictest sense began in the 1960s with the discovery of chemical vapor deposition (CVD) and physical vapor deposition (PVD) techniques. In recent times, modern deposition techniques such as thermal splashes and laser coatings have become more popular and can provide significant performance as quickly as possible. Currently, diffusion and coatings are used to provide resistance to corrosion and oxidation to prolong the life of the components. However, as the operating temperatures of the heat engines have increased, it has become impossible to achieve the required lives using diffusion coatings, while the cover coatings have worked better in aggressive environments at high temperatures. The corrosion way of behaving of the coatings depends on the following factors:

1. Corrosive media.
2. Substrate and its surface state.
3. Environmental temperature.
4. Composition, structure, porosity.

2.3. Detonation Gun Spraying

The Detonation gun spray (DGS) is a thermal spray process that offers very good adhesion, low porosity and surface coatings with residual compressive stress. The accurately measured amount of oxygen combustion mixture and acetylene is postulate into the closed tubular tube at one end. To avoid possible defects, a layer of nitrogen gas can packaging the gas inlets. At the same time, a predetermined amount of coating powder is postulate into the combustion chamber. The gas mixture inside the chamber is burned with a single candle. The combustion gas mixture creates shock waves at high pressure (detonation wave), which is then distributed by means of the gas stream. Depending on the proportion of flue gas, the temperature of the hot gas stream can reach 4000 ° C and the shock waves can reach speeds of 3500 m / sec. The hot gases from the detonation chamber, which move along the gun at high speed and are particles heated to the plasticizing step (only melting particles), as well as accelerate the particles at a rate of 1200 m / sec. Then these particles leave the barrel and act on the component that holds the manipulator to form a coating. The maximum kinetic energy of the particles of the hot powder during the impact with the substrate proceeds to the formation of a very dense and stable coating. The deepness of the coating developed in the piece by cooking depends on the ratio between the particle size of the powder, the carrier gas flow, the frequency and the distance between the end of the cylinder and the substrate. According to the required coating thickness and the type of coating material, the knock sputtering cycle may be repeated from 1 to 10 cycles per second. Finally, the chamber is rinsed again with nitrogen to remove any "hot" dust particles left in the chamber, otherwise it can inadvertently explode the explosive mixture and make the whole process uncontrollable.

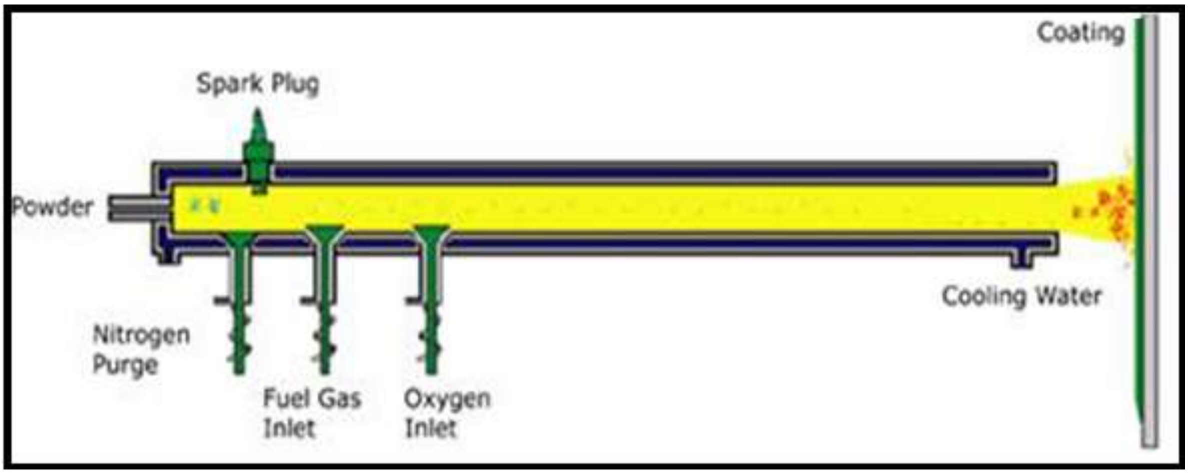

Figure 1: Schematic typical across section of detonation gun spray coating

In this case, the detonation cycle ends above the procedure and is repeated at a certain frequency until the required coating thickness is applied. Finally, the chamber is rinsed again with nitrogen to remove any "hot" dust particles left in the chamber, otherwise it can inadvertently explode the explosive mixture and make the whole process uncontrollable. In this case, the detonation cycle ends above the procedure and is repeated at a certain frequency until the required coating thickness is applied.

2.4. Substrate Material

The substrate material used in these day for study is Inconel-600 coated with Al2O3-40% TiO_2 powder. The substrate is chosen to study the oxidation property of the blades, gaskets and combustion chambers of the gas turbines including rotors and seals of the turbocharger, the electric shafts of the submersible well pumps, the fasteners high temperature, chemical treatment and pressure pipes. Main components in nuclear pressure water reactors, etc. To reduce oxidation losses, the surface coating was carried out by means of a thermal spray coating with a detonatory gun. The nominal composition of the substrate material is Ni- 72%, Cr- 14-17%, Mn-1%, Cu- 0.5%, Si- 0.5%, C-0.15%, S-0.015%.

Before oxidation &hot corrosion:

Figure 2: uncoated Inconel-600

Figure 3: Coated Inconel-600

After Oxidation

Figure 4: Uncoated Inconel-600

Figure 5: Coated Inconel-600

After Hot Corrosion

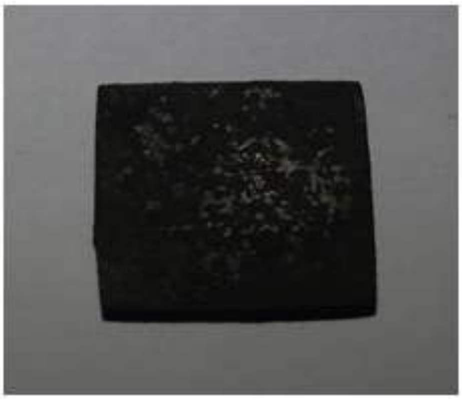

Figure 6: Uncoated Inconel-600

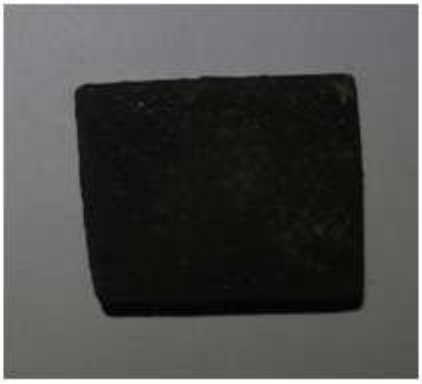

Figure 7: Coated Inconel-600

3. Result and analysis

3.1. Oxidation Kinetics

The mass gain graphs for the coated and uncoated substrate are shown in Figures 8 and 9 in the existence of air at 800 ° C. On the Y axis, "gain / area of weight (mg / cm2)" and the "x number of cycles". In the matter of air oxidation, the behavior of Inconel-600 in the air was quite linear, because the oxide layer formed on the substrate used to clean the skin was very easy and compared with that of the Inconel-600.Fig.8,9 shows plot of (weight gain/area) vs. Number of cycles. In this plot every curve is represented by straight line of same color. This straight line is trend line and it is used the Table 4 for calculating rate constant (KP). The kinetics of oxidation may be define by evaluation by parabolic rate constant value Kp, which was found by the following rate equation: $(\Delta W/A)2/t = Kp$ where $(\Delta W/A)$ was the weight change measurement per unit surface area and Kp the parabolic oxidation rate constant, t the cooling time. The square of weight gain data were plotted withreference to the number of cycles as shown in fig.8 & fig.9. Every curve or line in graph is having its nearly same equation which is represented below. For Inconel-600 air oxidized bare sample the approximated curve equation is,
y=1E-05x-3E-06
$R^2 = 0.963$

For Inconel-600 air oxidized $Al_2O_3 + 40\%TiO_2$ coated specimen the approximated curve equation is,
y=4E-06x+6E-05
$R^2 = 0.897$

3.2. Hot Corrosion Kinetics

Phenomenon of hot corrosion may be define by evaluation by parabolic rate constant value Kp, which was found by the following rate equation: $(\Delta W/A)2/t = Kp$ where $(\Delta W/A)$ was the weight change measurement per unit surface area and Kp the parabolic rate constant, t is the cooling time. The square of weight change data were plotted with reference to the number of cycles as shown in fig.8& fig.9; the trend line graph is plotted in fig.8,9 that represent the linear line and the approximate equation on line or curve graph which is given as.

For Inconel-600 salt oxidized bare sample the approximated curve equation is,
y=2E-05x+4E-05
$R^2 = 0.970$

ForInconel-600 salt oxidized $Al_2O_3 + 40\%TiO_2$ coated sample the approximated curve equation is,
y=9E-06x-7E-06
$R^2 = 0.884$

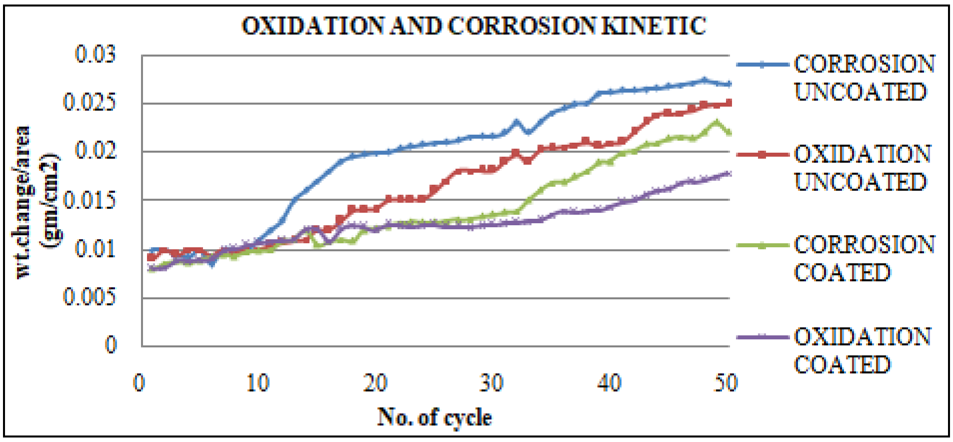

Figure 8: Graph plot for Weight change/Area vs. number of cycles for uncoated and coated Inconel-600 subjected to cyclic oxidation and hot corrosion for 50 cycles in molten salt environment and air at 800°C

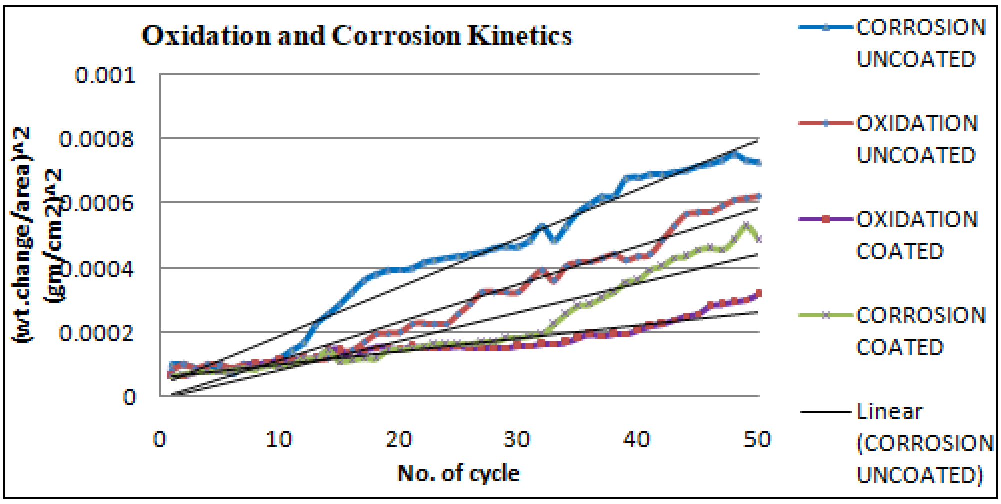

Figure 9: Graph plot for (Weight change/Area)^2 vs. number of cycles for coated and uncoated Inconel-600 subjected to cyclic oxidation and hot corrosion for 50 cycles in air and molten salt environment at 800°C

(Where Y is weight gain/area and X is number of cycle & these equation are calculated by using analysis mode of Origin software)

Table 1: Value of parabolic rate constant

Description	KP(10^{-6} g^2 cm^{-4} s^{-1})
Inconel-600 bare air oxidized	2.98276 X 10^{-4}
Inconel-600 Al_2O_3 + 40%TiO_2 coated air oxidized	1.6503 X 10^{-4}
Inconel-600 bare salt oxidized	4.25534 X 10^{-4}
Inconel-600 Al_2O_3 + 40%TiO_2 coated salt oxidized	2.21245 X 10^{-4}

4. Conclusions

The degradation of alloys and metals because of hot corrosion has been considered a dangerous problem for many applications in aggressive environments at high temperatures. Alluminide coatings can be completely deposited on the substrate material by HVOF, detonation gun and plasma spray processes. Al2O3 + 40% TiO2 coatings offer excellent resistance to corrosion and oxidation, they also have a higher melting point and maintain high strength, resistance and wear resistance at high temperatures. The erosion resistance of cermet coatings progress with the scale up of chromium carbide in pre-sprayed powder. Researchers agree that carbide coatings provide best protection against erosion, but do not agree on the optimal amount of carbide for optimal resistance to erosion. Thermally sprayed coatings are oxides and voids that emerge from the sputtering process and are detected at the projection boundaries, through which the coatings have been primarily attacked. Therefore, the requirement is to use denser coatings that degrade less due to their plus. Detonation of pistol with liquefied petroleum gas as combustible gas has been with excellent results used to deposit Al2O3 + 40% TiO2 alloy coatings on the materials of the boiler tube. Under the given sputtering parameters, the laminar structured coating is apparently dense with a thickness in the desired range of 250 to 400 µm. The accumulated weight gain for all Inconel-600 materials coated with detonation gun is significantly lower than the uncoated sample subjected to hot corrosion in 50% Na2SO4 + 50% molten NaCl at 800 ° C on 50 cycles. Uncoated samples experienced a higher corrosion rate and intense scaling of the oxide scale was observed. The main constituent of the oxide scale formed in all samples is iron oxide. The acid flow of the oxides by the mixture of molten salts led to a massive scale of porous oxide. The entire coated sample shows a characteristic thick protective oxide layer composed of oxides and spinel oxide of the active elements of the coating and imparting hot corrosion resistance in the given salt environment. The curves of variation of weight for oxidation in both cases follow the parabolic law. However, several authors have tried to understand the phenomenon of hot corrosion by using carbide coatings in various aggressive laboratory environments, but the long term exposure of these coatings in industrial environments should be intentional to assess the properties of protection of these coatings.

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