Comparative Study of SS 301 As Potential Material For Gas Turbine Disc

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Abstract- *SS 301L (S30100), SS301 LN which contains up to 8 % of Nickel, and 18 % of chromium is most recognizable and most often individual from treated steel family and a critical restricting element in early jet engines were the presentation of the materials accessible for the hot segment (plate) of the engine. The requirement for better materials prodded a lot of exploration in the field of composites and creating strategy and that examination brought about an extensive rundown of new materials and techniques that make current gas turbines conceivable. In the current study, the experimental investigations have been carried out to find the properties of as SS 301 as gas turbine disk material. The computation fluid dynamics analysis was also done to validate the experimental results.*

Keywords- SS 301, IN 718, IN 706, A 286, Gas Turbine Disc

I. INTRODUCTION

As turbine passage temperatures increment to further develop gas turbine effectiveness, gas turbine motor hot segment parts are compelled to oblige progressively higher burdens and temperatures. It will require turbine cutting edge materials to have astounding mechanical properties in high temperature climate. Nickel-based super alloys like single gem,directionally hardened composite is widely utilized for assembling of cutting edges of gas turbine motors due to their astounding microstructure depend ability furthermore, mechanical execution at high temperatures [1]. Not with standing, there might be fuel deposits (like vanadium and sulfur) in turbine parts in gas turbine motors. In the meantime, salts ordinarily enter the turbine through the air channel and store on the outer layer of the hot segment parts in seacoast or marine environments[2]. Accordingly, the turbine cutting edge has a mix of surface temperature and testimony conditions, so it can incline to limited hot erosion [3], in demonstrate hatred for of materials steadiness. That implies edges and spouts nearest to the combustor work in gas way temperatures far surpassing their liquefying point and are cooled to satisfactory help temperatures (commonly eight-to nine-tenths of the liquefying temperature) to keep up with respectability [4]. Cross segment of a gas turbine is displayed in Fig. 1 [5], which comprises of a critical number of single gem and DS speculation cast part.

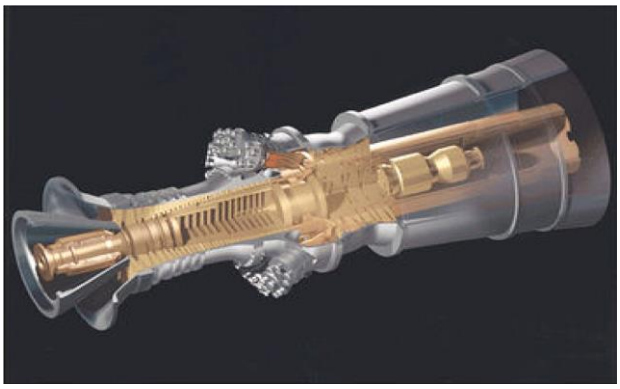

Fig. 1 GE 'H' 480 MW gas turbine [5]

Hot corrosion is generally classified either as high-temperature hot corrosion (HTHC), which regularly happens inside the 850-950°C temperature each, or low-temperature hot consumption (LTHC), which generally happens inside the 650-800 °C temperature range [6]. The most high-level turbine plates produced using powder metallurgy (PM) composites work at a pinnacle edge temperature of 704 °C and are exposed to LTHC(i.e., Type II hot consumption) harm [7]. By the by, as a critical part of gas turbine motors, turbine edges can endure temperatures of roughly 720-870 °C during the voyage, and their all-out help time is in excess of 10,000 h [8]. In this way, the outrageous assistance climate looked in present day gas turbine motors implies that turbine edges ordinarily experience HTHC.

Gas turbine circle must be oppressed high tension, high temperature, and vibration condition inside gas turbine. These variables are answerable for disappointment of gas turbine circle and cutting edges, damage of motor. So, the amalgam which is utilized in gas turbine plate material must be high liquefying point. Liquefying temperature of SS 301 is similarly close thus called high then current situations yet in addition less expensive in cost and accessibility is more straightforward. SS301 contains up to 6-8 % Ni, and 16-18% Cr which makes Tempered steel great erosion opposition. SS 301 is designing material with great consumption obstruction,

strength and manufacture qualities. They can be meet a wide spot of configuration limits, for example, load, cycle life and support cost. Austenitic treated steels have a convoluted mechanical property at room temperature, conduct contrasts are changed to a sequential dependability connected with martensite change. In this regard Stainless Steel Grade 301 is proposed a potential material for gas turbine disc. Along with the experimental work, computation fluid dynamics studies have also been carried out to analysis different mechanical properties such as stress analysis etc.

II. MATERIAL FOR GAS TURBINE BLADE

The composites expect for gas turbine blade are by and large elite execution super combinations. These compounds can be reinforced by different solidifying strategies. Super combinations contain great oxidation and creep opposition and are accessible in various shapes. These compounds can work under exceptionally high mechanical pressure and high temperature and at places which require high surface soundness. Some of the common materials used are given below:

a) Alloy 718 Nickel-Based Alloy
b) Alloy 706 Nickel-Based Alloy
c) A286 Alloy
d) STAINLESS STEEL GRADE 301

Hardened steel 301 is exceptionally consumption safe because of higher measure of chromium (least of 16%) content in it which gives SS301 both oxidation and erosion obstruction. This steel likewise contains of other fundamental components in it, for example, manganese, nickel and molybdenum to further develop its consumption obstruction property. Treated steel grade 301 is fabricated as strips and wires, to deliver tempers going from 1/16 Hard to Full Hard.

III. TEST EQUIPMENT AND METHOD

The plan and assembling of gas turbines for power age framework is indicated/controlled by the AmericanOil Foundation Standard 616 (little to middle of the road motors). Gas turbine warm proficiency increments with expanding temperature of the gas stream leaving the combustor, furthermore, entering the work-creating part — the turbine.

Fig. 2 Tensile testing Machine

Turbine passage temperatures (TET) in the gas way of current superior execution land-based gas turbines work at1,600 C or lower. In high-temperature areas of the turbine, extraordinary high-liquefying point nickel-base super alloy edges and spouts (vanes), which hold strength and stand up to hot consumption at outrageous temperatures, are utilized. Figure 2 showed the photograph of tensile test machine

IV. EXPERIMENTAL ANALYSIS

It was observed that upto a temperature of around 482°C, the brief time frame ductile properties are generally significant. These are property estimation that can be utilized where parts are not presented to high help temperature for broadened timeframes. The standard test for these properties is directed after the test example have been held at a temperature to protect consistent temperature all through ordinarily around 30 min. the information mirror no impact of long-time openness to high temperature[9].

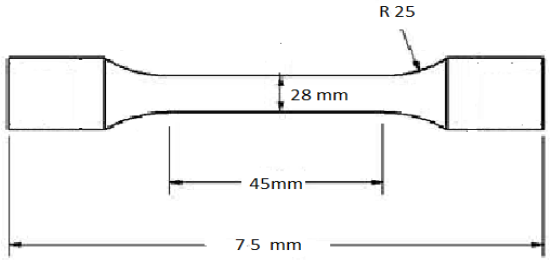

Fig. 3 Tensile test specimen (mm)

V. COMPUTATIONAL ANALYSIS

Computation fluid dynamics (CFD) is one of the prominent software to do simulation work of many engineering problem [10]. The involves the principle of fluid dynamics and het transfer. There are many applications such

as analysis of solar air heater, simulation of combustion phenomenon happened inside the cylinder etc. have been done with the help of CFD [11-15]. In the current study a new material was proposed as a gas turbine blade material. The mechanical properties such as tensile strength, displacement analysis, facto of safety etc. were carriedout with the help of CFD and results were presented in this section.

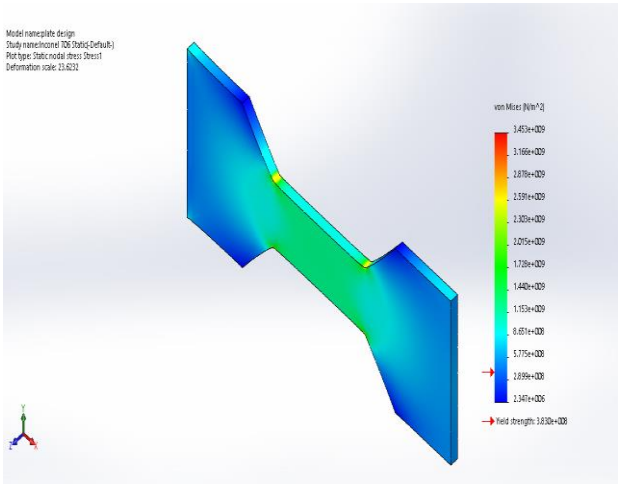

Fig. 4 Stress analysis of Inconel 706

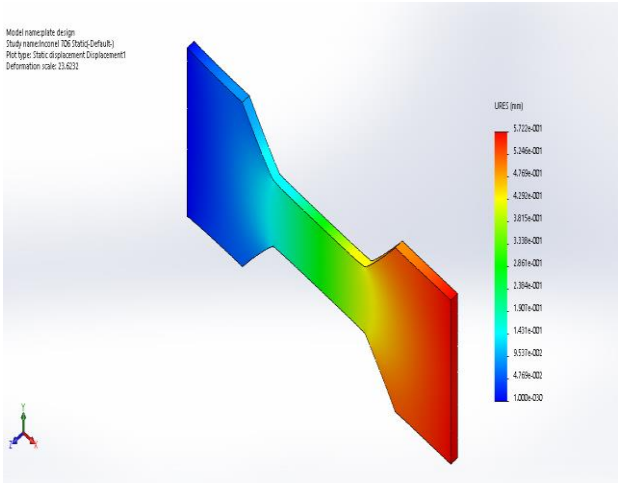

Fig. 5Displacement analysis of Inconel 706

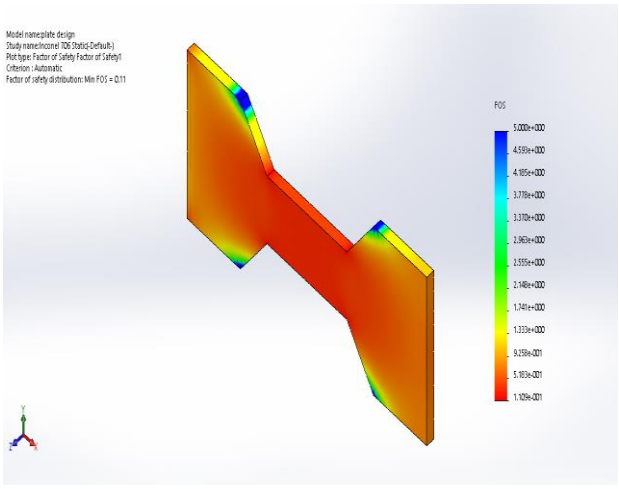

Fig. 6 Factor of safety analysis of Inconel 706

VI. CONCLUSION

Hardened steel 301 has different applications in different fields. By near examination of SS 301 with different combination previously utilized in gas turbine circle found that the properties of SS 301 are very like the ongoing situations however cost considerably more less expensive than others. In the short to medium term proceeded with improvement of new existing materials will be required anyway in the long haul as new materials are presented for potential purposes in Gas turbine Circle and their related advances should be created as an essential piece of conveying of the general materials framework arrangement. At long last we finish up the examination of Mechanical Property of SS301 work on the Property and proficiency and looking at Gas turbine circle utilized Material are higher in cost as contrast with SS301 and SS301 can be probability to use in Gas turbine Plate for different intensity therapy process builds the property.

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