International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

Analyzing Deformation of Steel using Software Simulation

Praveen Gagrai
Production engineering
B.I.T Sindri
Dhanbad India

Subodh Kumar
Assistant Professor
Production Department
B.I.T Sindri, Dhanbad India

***Abstract*:- The possibility of application of the plane strain compression test (PSCT) to the determination of the flow stress was evaluated. It was shown that distributions of strains and stresses are very nonuniform, that makes interpretation of results difficult. Inverse analysis eliminates effects of inhomogeneities but in the case of the PSC it involves high computing costs to improve the efficiency.**

1. INTRODUCTION

steels are subjected to high mechanical loads and harsh environmental condition. The main loading components are rolling contact pressure, shear and bending forces from the vehicle weight, and thermal stresses due to restrained elongation of rail steel. The development of high strength rail steel grades is major concern for a large number of steel manufacturers. The mechanical properties of high strength rail steel can be remarkably improved through proper alloy design and appropriate thermo-mechanical processing steps like rolling that can refine and homogenize the final microstructure. Rolling is approximated to plain strain compression (PSC). Therefore thermo mechanical processing conditions like rolling of rail steel can be understood by performing plain strain compression testing in a thermo mechanical simulator. It is also observed that the strain distribution in the sample is not uniform across the thickness of the sample during PSC and estimation of critical zone which experiences the true plain strain compression is important. By analyzing the mechanical properties and micro structure variations of the gleeble PSC test sample and generating the strain distribution through simulation of PSC test with the help of simulation softwares. This project aims to correlate the microstructural evolution during deformation with respect to strain distribution.

2. DETAILS EXPERIMENTAL

A series of three experiments, each consisting of three equal parallels, were run to study plane strain compression, testing in a *physical metal forming simulator;* The experiments were run at room temperature, and the specimens were lubricated by graphite; the workpiece material was a soft-annealed AA 6082 Al alloy. More details about the experiments are given elsewhere.3 Since the Gleeble machine had rather low compression force, specimens of very large breadth in relation to thickness were not used, though that is generally recommended, to minimize lateral flow.

2.1 PSC simulation

The model has been carried out using simulation software. The modeling has been done in ansys. The simulation has done in ansys to measure the parameter of rolling like stress strain and temperature. The aim of finite element simulation of PSCT is to predict the evolution of force acting on tools as much correctly as possible. Comparison between the measured forces and the predicted ones allows one to estimate anadequacy of constitutive equations used for simulation. The constitutive equation constants then should be iteratively corrected to minimize the deviations between the measured values and the predicted ones. 3D FE simulation produces more accurate results but it is also time consuming for use in the inverse analysis. At the same time, the conditions of metal flow during PSCT are very close to ideal plane strain deformation so 2D FE simulation could by efficiently used.

3. RESULTS AND DISCUSSION

steel samples of standard chemical composition were tested at constant nominal temperature of 1000°C in nominal strain rate range of 0.01 - 10 s-1 and at constant nominal strain rate of 1 s-1 in the temperature range of 800 - 1100°C. Prior to deformation the specimens were heated to a temperature of 1200°C, held one minute and cooled to the temperature of deformation. The initial specimen geometry was a brick of 20 mm wide, 15 mm long and 10 mm thick. The specimens were deformed by the tool of 5 mm thick to the nominal stain of 1. Graphite lubricants and tantalum foils were used in order to eliminate friction between specimens and the tools. The temperature was measured by a thermocouple placed in the middle of the lateral surface of the specimen. The experiments were performed on Gleeble 3800 testing machine. The data obtained during the tests were reordered to a protocol containing the following information: current time, measured load, measured specimen temperature, measured displacement of the tool, nominal displacement of the tool, nominal temperature, calculated value of the effective strain, calculated value of the effective stress. Thus, only four parameters are measured during the test: time, load, displacement and temperature.

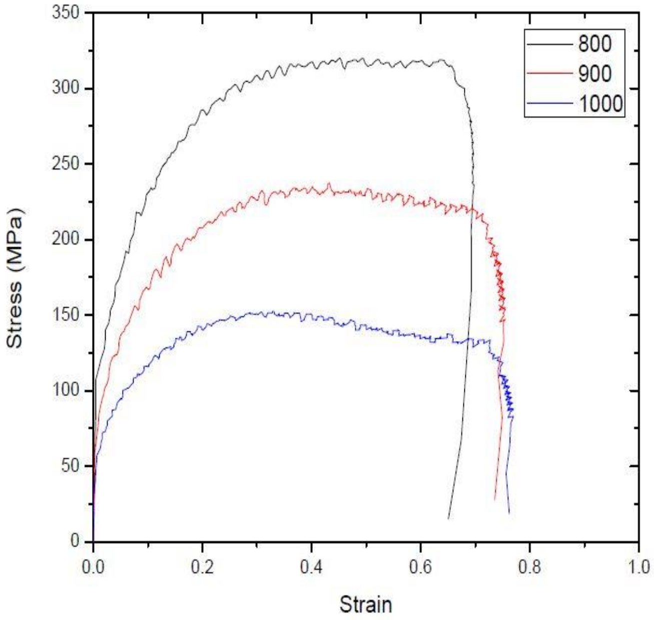

Figure no (1): Stress vs Strain curves

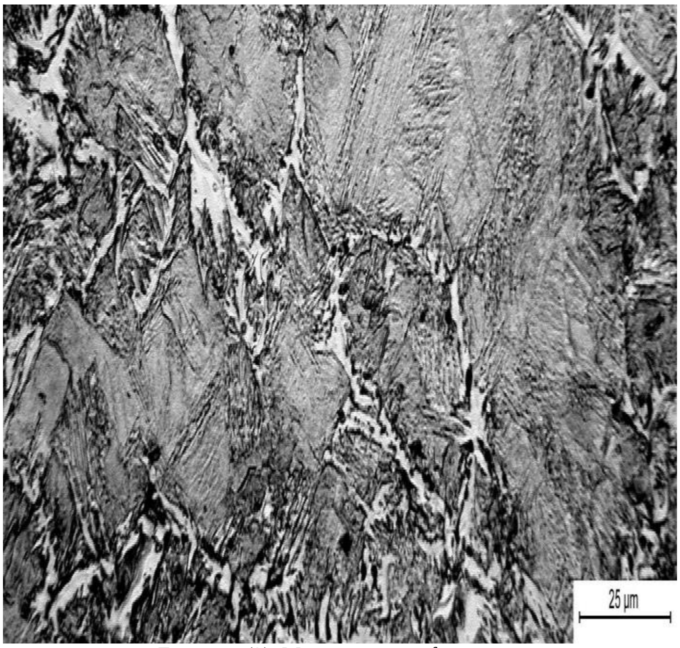

Figure no (2): Micro structure of specimen

Table no (1): DRC parameters at different temperatures

Temp	**850**	**950**	**1050**
Critical Stress,σ_c	343	245	167
Critical Strain, ε_c	0.45	0.25	0.13
Peak Stress,σ_p	333	220	140
Peak Strain,ε_p	0.33	0.31	0.28

3.1 Microstructural Investigation

Fig.2 shows the optical micrographs It is a microstructure of ferrite in steel and it is characterised by needle shaped microstructure (in view of 2D) and it is advantages over other microstructure because it has chaotic ordering (Lack of order) which increase the toughness because acicular ferrite nucleate in a non-homogenous manner on a small nonmetallic inclusion along it boundary and expand in many different direction from the point of nucleationsited of non-metallic inclusion. By this above characteristics the cleavage crack does not cross the grainboundary of acicular ferrite because its having the property of high of high angle grain boundary which radiate the cleavage crack in another direction. By this way it gives the superior characteristics of material which is known as toughness.

3.2: Simulation

The simulation of PSCT of steel was performed in order to study flow inhomogeneity occurr during test Finite element analysis was performed in order to study flow inhomogeneity occurring in a specimen during the tests. The software realizing numerical simulation of the tests was developed by the authors on a basis of SPLEN [3] FE code. Axisymmetric FEM formulation was used to simulate the UC tests, for the simulation of the PSC tests, 2D plane FEM formulation with the corrections proposed in [11] was used to simulate PSC tests. The temperature of a specimen was considered to be distributed uniformly by its volume and varied in time according to the values recorded during the test. The distributions of the effective strain rate and the effective strain obtained by the simulations of PSC test at nominal strain rate 1 s-1 and UC test at nominal strain rate of 10 s-1.

4. CONCLUSION:

The studies of steel was carried out by using simulation and Gleeble physical simulation. The process parameter of steel properties can be done by softwaere simulation. The trends of parameters are same as compare to physical and software simulation The effect of process parameters on the micro structure, DRC behavior and properties were studied.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

REFERENCES

[1] Herian, J., and K. Aniołek. "The structure and properties of steel with different pearlite morphology and its resistance to abrasive wear." *Archives of Materials Science and Engineering* 31.2 (2008): 83-86.

[2] Dobrzański, L. A., W. Borek, and M. Ondrula. "Thermomechanical processing and microstructure evolution of high manganese austenitic TRIP-type steels." *Journal of Achievements in Materials and Manufacturing Engineering* 53.2 (2012): 59-66.

[3] Mishra,dipeshkumar. *Thermo-mechanical Processing of API-X60 grade pipe line steel*. Diss. 2014.

[4] Deform 3d user manual,(2008)

[5] Raju, B. Padma, and M. Kumara Swamy. "Finite Element Simulation of a Friction Drilling process using Deform-3D." *International Journal of Engineering Research and Applications* 2.6 (2012): 716-721.

[6] SIMULIA, "Full vehicle Durability UsngAbaqus/Standard to Abaqus/Explicit Co-simulation," *Abaqus Technology Brief*,November 2011