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Analysis of Rolling Process with different Rolling Speed and Roller distance to predict Stress and Plastic Strain effects

Rohit Yadav[1], Prof. Tanmay Awasthi[2]
[1]M.Tech.Scholar, Department of Mechanical Engineering[1], SIRTE, Bhopal, India
[2]Professor, Department of Mechanical Engineering[2], SIRTE, Bhopal, India

ABSTRACT

In the current work, the CAD model of rolling process with different roller distance profile has been developed in ABAQUS (CAD) domain, the model had been simulated using ABAQUS software on structural domain, in order to predict various parameters influencing the formability of aluminium 6056 material during deep drawing process with different roller distance. Six type of configuration of rolling process with different roller distance including validation model have been considered. The simulation of the optimized models i.e. 4.5mm of roller distance gives nominal value of stress and plastic strain at different rolling speed of 50, 60, 70, 80, 90 and 100 (mm/sec) which has optimized and converged result as compared to respected models of different roller distance model in rolling process. The configuration of optimized model gives maximum convergence on all parameters amongst all the configurations used.

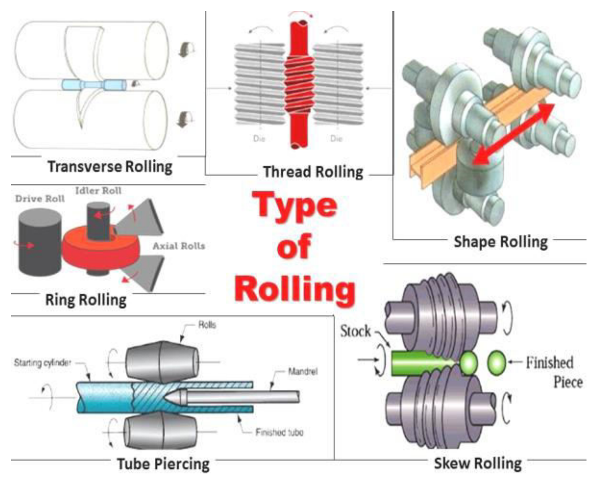
Keywords – Rolling Process, Vonmises stress, Plastic strain, Rolling speed, Aluminium 6056.

I. INTRODUCTION

1.1 Rolling Process

Rolling works concerning equal so anybody other metallic co nstructing process. When a compressive force utilized through a set regarding rolls on in got or someone other product as blooms then billets, plastic deformation takes vicinity as decrease its go quantity region then alter it within required shape.

II. TYPES OF ROLLING PROCESS



2.1 Application of rolling:

Rolling is chronic because making hole seamless tubes, rods etc.

- Large extent pass sections are evolved through rolling process.
- It is usage because of article production regarding threaded parts as screw, bolts etc.
- Gears perform lie cut on tools blank by using rolling process.
- Construction material, cantonment panels, part beams, railroads, etc. are rolling product.
- It is aged in car industries because of generation more than a few parts.
- Rings of turbines, hold then ignoble machines are rolling product.
- Steel sheets, plates are committed by using rolling process.

III. RESEARCH METHODOLOGY

3.1 Procedure for solving the problem

- Modeling of the geometry.
- Meshing of the created model.
- Define material properties and boundary conditions.
- Running the solution of domain.
- Obtaining the results.

3.2 Preparation of the CAD models

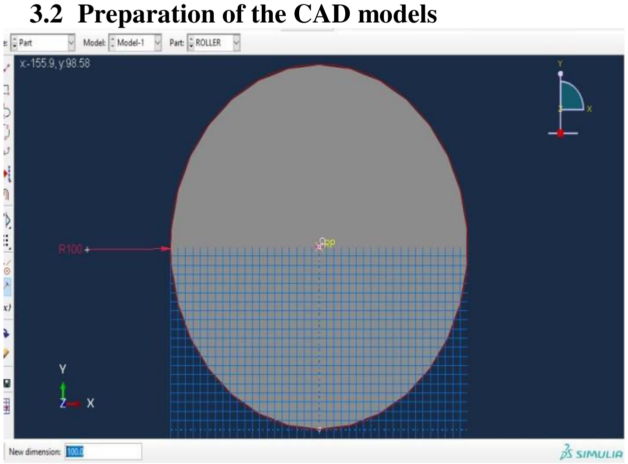


Figure 1 – model of roller for rolling process

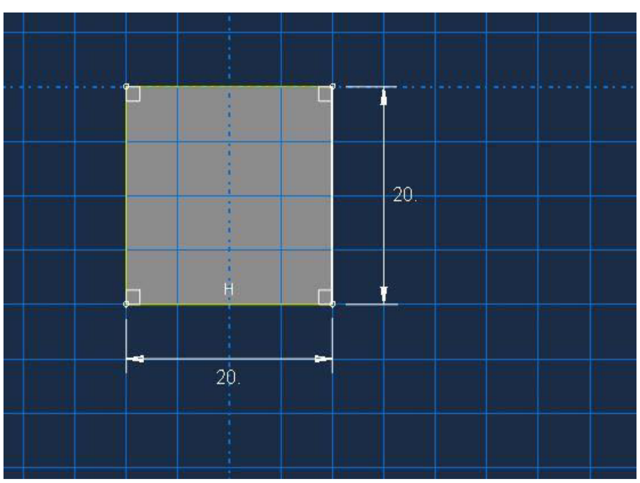


Figure 2 – model of rolling material for rolling process

3.3 Meshing of the Domain

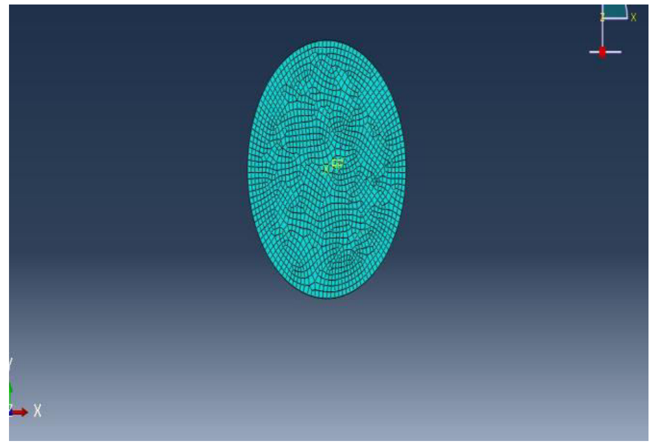


Figure 3: Mesh model of roller.

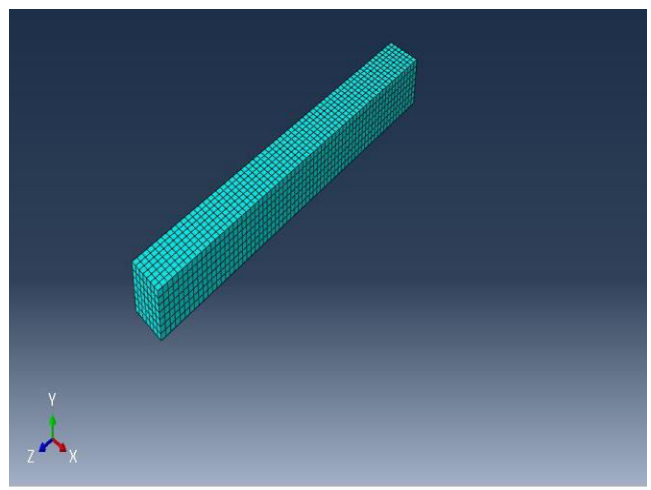


Figure 4: Mesh model of rolling material.

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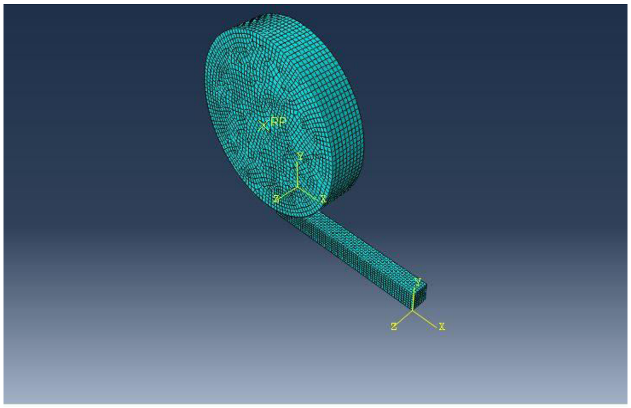

Figure 5: Mesh model of rolling components.

3.4 Description of material properties

Aluminium 6056

Table 1: Materials Properties

Physical Properties	
Young' s Modulus (Pa)	7.00e + 013
Poission's Ratio	0.33
Density (Kg/m3)	2700

IV. RESULTS & ANALYSIS

Table 2 - Validation result for rolling process structure at different rolling speed.

Roller distance (3mm) (Validation)		
Rolling speed (mm/sec) (Validation)	**Stress (MPa) (Validation)**	**Plastic Strain (Validation)**
50	73.8	1.28
60	76.2	1.36
70	79.4	1.43
80	82.6	1.56
90	85.3	1.68
100	87.9	1.73

Result obtained from ABAQUS for roller distance of 3.5mm with different rolling.

Table 3 – Result for rolling process with roller distance of 3.5mm at different rolling speed.

Roller distance (3.5mm)		
Rolling speed (mm/sec) Roller distance (3.5mm)	**Stress (Mpa) Roller distance (3.5mm)**	**Plastic Strain Roller distance (3.5mm)**
50	71.6	1.26
60	74.1	1.34
70	77.3	1.39
80	80.6	1.54
90	83.9	1.63
100	86.8	1.66

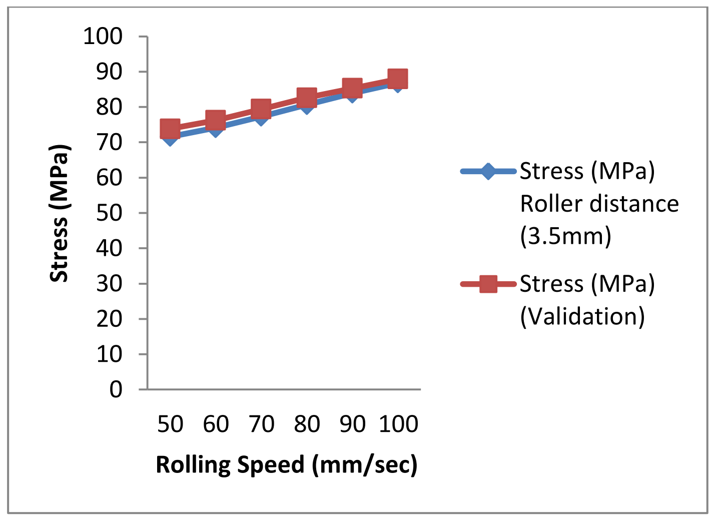

Figure 6 – Comparison of stress with roll distance of 3.5mm at different rolling speed.

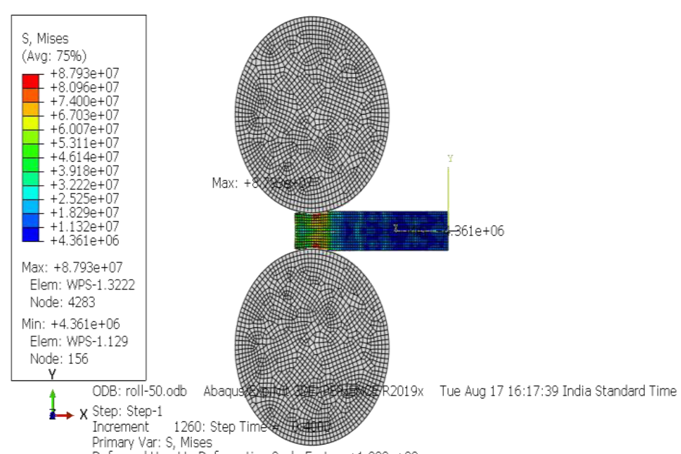

Figure 7 – Stress for rolling process structure at roller distance of 3.5mm with different rolling speed.

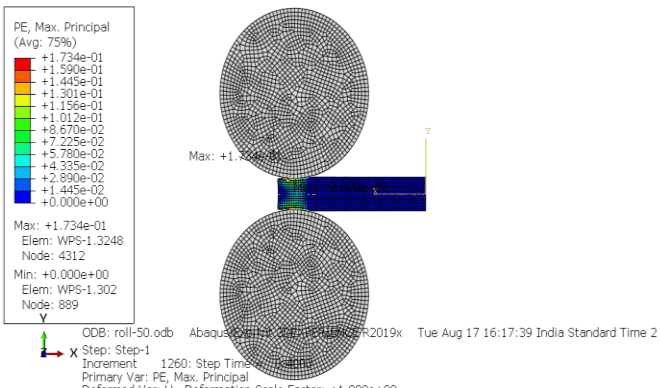

Figure 8 – plastic strain for rolling process structure at roller distance of 3.5mm with different rolling speed.

Result obtained from ABAQUS for roller distance of 4mm with different rolling.

Table 4 - Result for rolling process with roller distance of 4mm at different rolling speed.

Roller distance (4mm)		
Rolling speed (mm/sec) Roller distance (4mm)	**Stress (MPa) Roller distance (4mm)**	**Plastic Strain Roller distance (4mm)**
50	70.5	1.23
60	73.8	1.29
70	76.9	1.32
80	81.4	1.38
90	82.3	1.42
100	85.6	1.51

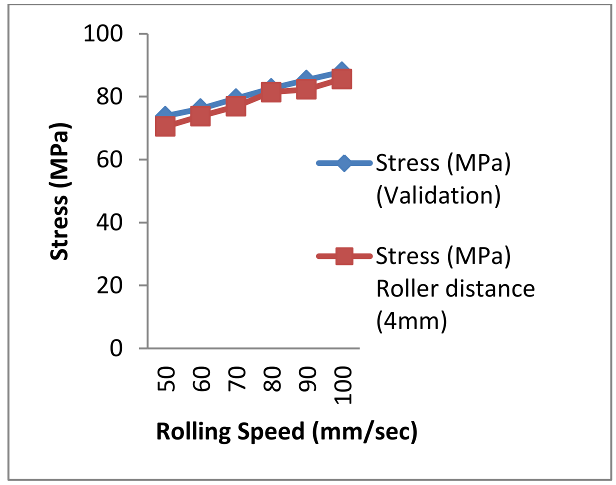

Figure 9 - Comparison of stress with roll distance of 4mm at different rolling speed.

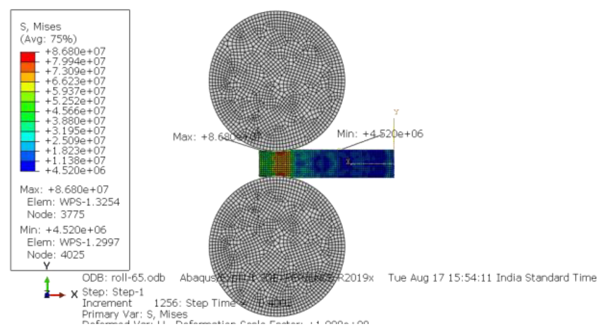

Figure 10 - Stress for rolling process structure at roller distance of 4mm with different rolling speed.

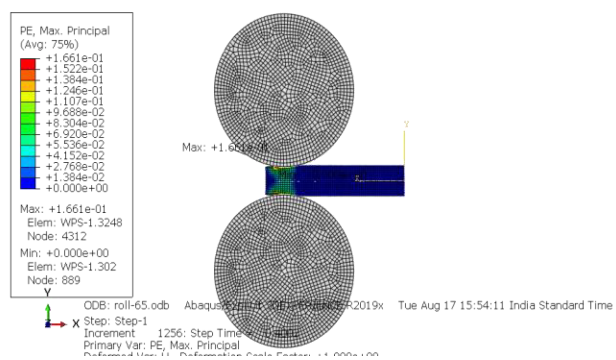

Figure 11 - plastic strain for rolling process structure at roller distance of 4mm with different rolling speed.

Result obtained from ABAQUS for roller distance of 4.5 mm with different rolling.

Table 5 - Result for rolling process with roller distance of 4.5mm at different rolling speed.

Roller distance (4.5mm)		
Rolling speed (mm/sec) Roller distance (4.5mm)	**Stress (MPa) Roller distance (4.5mm)**	**Plastic Strain Roller distance (4.5mm)**
50	68.9	1.25
60	72.3	1.28
70	76.8	1.32
80	78.9	1.36
90	81.7	1.39
100	83.4	1.42

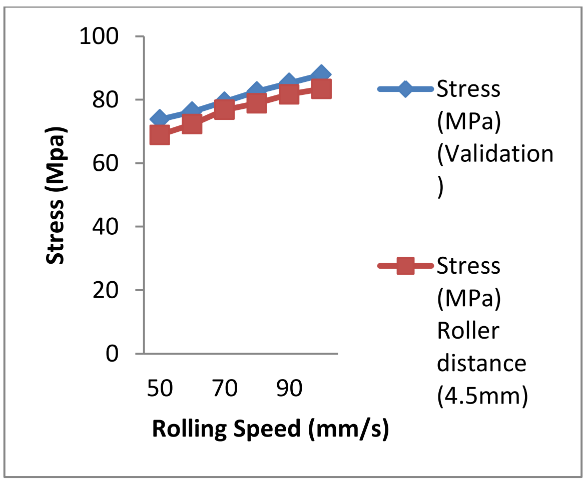

Figure 12 - Comparison of stress with roll distance of 4.5mm at different rolling speed.

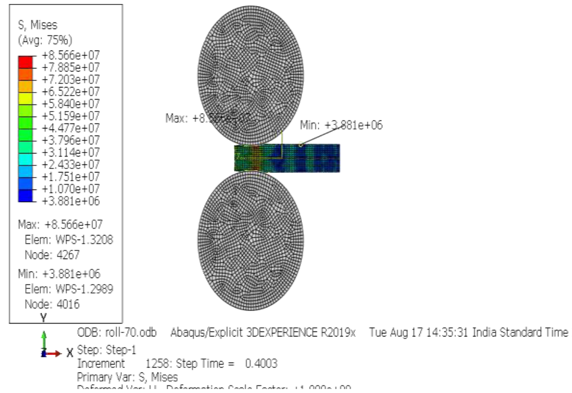

Figure 13 - Stress for rolling process structure at roller distance of 4.5mm with different rolling speed.

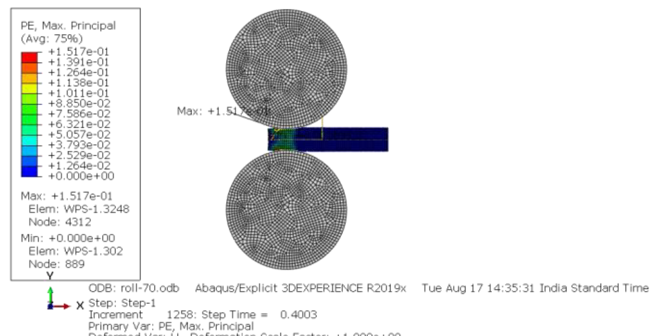

Figure 14 - plastic strain for rolling process structure at roller distance of 4.5mm with different rolling speed.

Overall comparison of stress and plastic strain of rolling process including different roller.

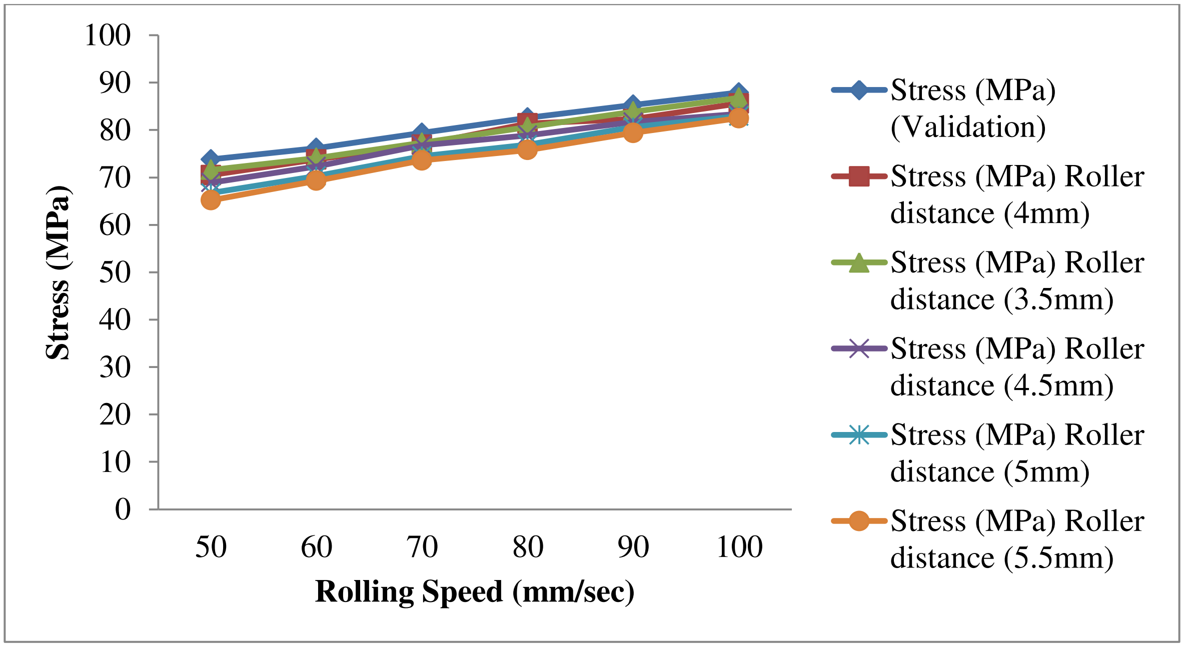

Figure 15 - overall comparison of stress in (MPa) with respect to rolling speed (N) in different roller distance in rolling process.

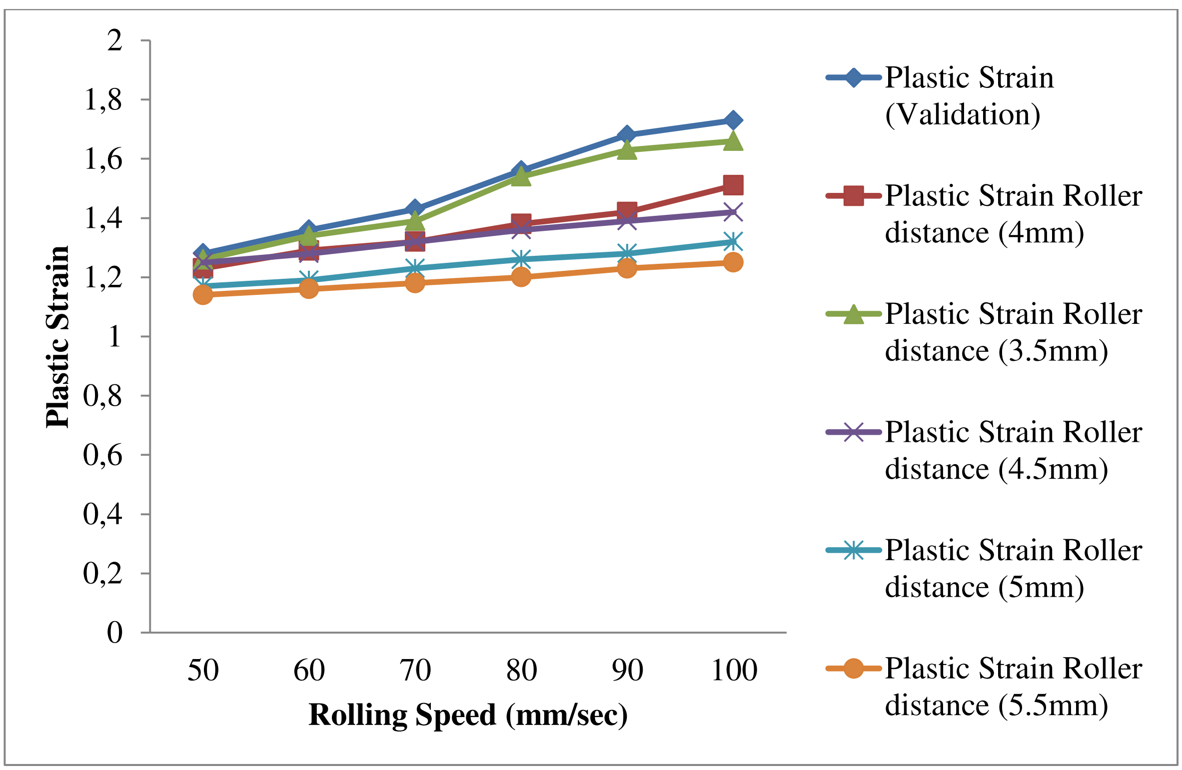

Figure 16 - overall comparison of plastic strain with respect to rolling speed (N) in different roller distance in rolling process.

Conclusion

1. The different roller distance in rolling model was developed on ABAQUS modelling domain and analysis was done using the ABAQUS software (Structural domain).
2. The stress distribution is the effective parameter in the structure stability of different roller distance profiles with different rolling speed i.e. 50, 60, 70, 80, 90 and 100mm/sec.
3. In the study rolling process with different roller distance i.e. 3mm (validation), 3.5mm, 4mm, 4.5mm and 5mm are the key geometric parameter on the performance of structural formability of aluminium 6056 material under different rolling speed with an implementation on rolling process with the developed stresses and structure homogeneity effect are improved.
4. The optimum result is observed in 4.5mm of roller distance with different rolling speed, it concludes that at rolling speed of between 70 to 80 (mm/sec), the obtained stresses are optimum as compared to other roller distance of rolling process.
5. The simulations of ABAQUS model of rolling process with roller distance show a good relation with base paper results presented in the literature [22].
6. It is also observed that roller distance of 3mm, 3.5mm and 4mm exhibits higher stress with high plastic strain which is higher due to this defect in rolling material is observed.
7. The roller distance of 4.5mm exhibits optimum stress and optimum plastic strain at each rolling speed which induces fewer defects in rolled material during rolling process. thus, these parameter could be considered for manufacturing process in rolling.
8. It could be concluded that rolling process with rolling distance of 4.5mm exhibits higher convergence in stress and plastic strain.

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