Figure (9) shows the microstructure of the engineering material after a cold rolling process, at the angle of the direction of rolling (0o) when the reduction ratio thickness of the engineering material (15% and 20% and 25% and 30%), shown in the figure that most of the components taken the horizontal direction, especially the two samples (A1 and A4) which shows the microstructure of the engineering material influenced by the direction of the formation process of the cold rolling.

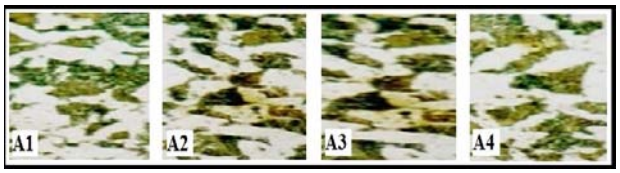

Figure 9: Microstructure of the medium carbon steel (DIN CK45) after rolling operation at angle (0 o)
A1: Draft 15 %, A2: Draft 20 %, A3: Draft 25 %, A4: Draft 30 %

Figure (10) shows the microstructure of the engineering material after a cold rolling process, when the angle of the rolling direction (30o) at the reduction ratio of the thickness of the engineering material (15%, 20%, 25% and 30%), and is shown in Figure that the microstructure of the Engineering material components inclined at an angle (30o).

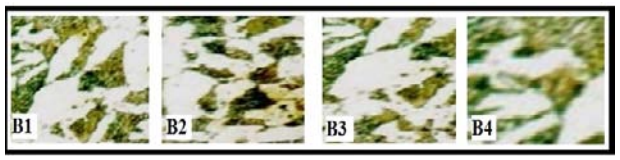

Figure 10: Microstructure of the medium carbon steel (DIN CK45) after rolling operation at angle (30 o)
B1: Draft 15 %, B2: Draft 20 %, B3: Draft 25 %, B4: Draft 30 %

Figure (11) shows the microstructure of the engineering material after a cold rolling process, when the angle of the direction of rolling (60o) at the reduction ratio 0f thickness of the engineering material (15%, 20%, 25% and 30%), and shows that the angle of the rolling direction (60o) that is clear influence in the microstructure.

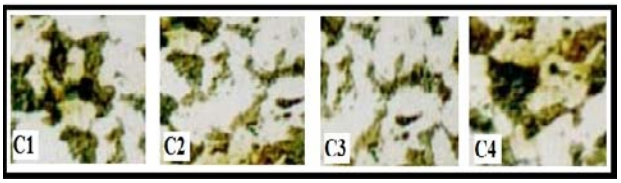

Figure 11: Microstructure of the medium carbon steel (DIN CK45) after rolling operation at angle (60 o)
C1: Draft 15 %, C2: Draft 20 %, C3: Draft 25 %, C4: Draft 30 %

Figure (12) shows the microstructure of the engineering material after a cold rolling process, when the angle of the rolling direction of (90o) at the reduction ratio of thickness of the engineering material (15%, 20%, 25% and 30%), samples components has appeared are moving toward vertical with very little change in varying proportions of the components of (0. 2%) compared with the sample before rolling when applying the manual counting method to calculate the components.

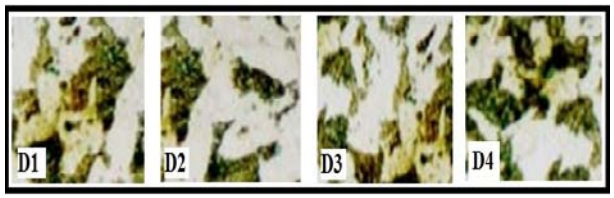

Figure 12: Microstructure of the medium carbon steel (DIN CK45) after rolling operation at angle (90 o)
D1: Draft 15 %, D2: Draft 20 %, D3: Draft 25 %, D4: Draft 30 %

5. Conclusions and Recommendations

5.1 Conclusions

In light of the results of the current study can be reached the following conclusions:

1. The rolling direction of angles located in the range (0< Θ < 90o) has had a clear impact in increasing the tensile stress, especially when the direction of the vertical rolling, in addition to its effect on the average flow stress of the engineering material through change in the value of real strain during the plastic deformation.
2. The amount of draft in forming operation by rolling process is proportional to the increase in the average flow stress of the engineering material.
3. Engineering material hardness of cold rolling increases with every increase in the amount of reduction in the thickness of engineering material.
4. There is an increasing in the amount of hardness engineering material in the rolling process when the direction of entry of the sample inclined relative to the line between the rolls.
5. Microstructure of the material does not change in ratios of components, but the changing in the arranging and the shape of the components after rolling operation.

5.2 Recommendations

1. It is possible to use the current search results to predict the strength and energy required for cold forming.
2. Use the data of the current search to compare with other metals, ferrous metals and alloys.

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