Flat-And-Shape-Rolling Processes

FIGURE 6.29

Kalpakjian • Schmid
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Pressure Distribution in Rolling

FIGURE 6.34 Pressure distribution in the roll gap as a function of the coefficient of friction. Note that as friction increases, the neutral point shifts toward the entry. Without friction, the rolls slip, and the neutral point shifts completely to the exit.

FIGURE 6.35 Pressure distribution in the roll gap as a function of reduction in thickness. Note the increase in the area under the curves with increasing reduction in thickness, thus increasing the roll-separating force.
Effects of Front And Back Tension

FIGURE 6.36 Pressure distribution as a function of front and back tension. Note the shifting of the neutral point and the reduction in the area under the curves with increasing tension.
Roll Bending and Workpiece Spreading

FIGURE 6.37 (a) Bending of straight cylindrical rolls (exaggerated) because of the roll force. (b) Bending of rolls, ground with camber, that produce a sheet of uniform thickness during rolling.

FIGURE 6.38 Increase in the width of a strip (spreading) in flat rolling. Spreading can be similarly observed when dough is rolled with a rolling pin.
FIGURE 6.42 Schematic illustration of various roll arrangements: (a) two high; (b) three high; (c) four high; (d) cluster; (e) tandem rolling with three stands; (f) planetary.
FIGURE 6.43 Schematic illustration of a cluster (Sendzimir) mill. These mills are very rigid and are used in rolling thin sheets of high-strength materials, with good control of dimensions.
Rolling Defects

- insufficient camber
- residual stress
- center cracks
- warping
- edge wrinkling

Mo bar rolled at high $\Delta$.

Rolling Defects

- over-cambered
- residual stress
- edge cracks
- splitting
- center wrinkling

Rolling Defects

Rolling Defects

“alligating”

Mo rod rolled at high $\Delta$.

FIGURE 6.40 The effect of roll radius on the type of residual stresses developed in flat rolling: (a) small rolls, or small reduction in thickness; and (b) large rolls, or large reduction in thickness.
Shape Rolling

FIGURE 6.44 Stages in shape rolling of an H-section part. Various other structural sections, such as channels and I-beams, are also rolled by this process.
Tube Rolling
FIGURE 6.48 Cavity formation by secondary tensile stresses in a solid round bar and its use in the rotary-tube-piercing process. This procedure uses the principle of the Mannesmann mill for seamless tube making. The mandrel is held in place by the long rod, although techniques have been developed in which the mandrel remains in place without the rod.
FIGURE 6.46 Thread-rolling processes: (a) flat dies and (b) two-roller dies. These processes are used extensively in making threaded fasteners at high rates of production.
FIGURE 6.47 (a) Schematic illustration of machined or rolled threads. (b) Grain-flow lines in machined and rolled threads. Unlike machined threads, which are cut through the grains of the metal, rolled threads follow the grains and are stronger, because of the cold working involved.
Changes in the grain structure of cast or large-grain wrought metals during hot rolling. Hot rolling is an effective way to reduce grain size in metals for improved strength and ductility. Cast structures of ingots or continuous castings are converted to a wrought structure by hot working.