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NEWS VIEWS

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Determination to Establish Excellence Through Efficiency and Expertise

COLD ROLLING MILL ROLLS

SPALLING

Chipping off, flaking, dismember of a portion from roll barrel is known as spalling. Spalling can occur in any roll while in use at mill.

Normally following are the factors involved in generation of spalling/ cracking.

SPALLED SURFACE CRACKS

(1) Deep Seated defects :- These are the defects which are inherently present in material. Spalled fracture face can be identified from oval shaped beach marks generated, going far from eye. Such defects lead to dismembering of a chunk from body. In extreme cases lead to splitting of barrel.

(2) Grinding of rolls :- Cracks are generated on roll surface due to improper grinding. The moment wheel meets the roll surface full flood coolant should be applied. Sparking should be avoided. Excess contact pressure will overheat roll surface forming soft patches and

TOP TOOLS DEWAS TOOLS

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fire cracks. Loaded grinding wheels give rise to roll surface temperature. Other errors that affect rolls are incorrect wheel balancing, wrong grade selection of wheel which gets loaded or becomes glazed, too much depth of cut, insufficient flow of coolant or contaminated coolant etc. All such mistakes result into stressing of roll which leads to formation of hairline cracks, spot burning, reduction of surface hardness etc.

Cracks on roll surface due to high depth of cut in grinding.

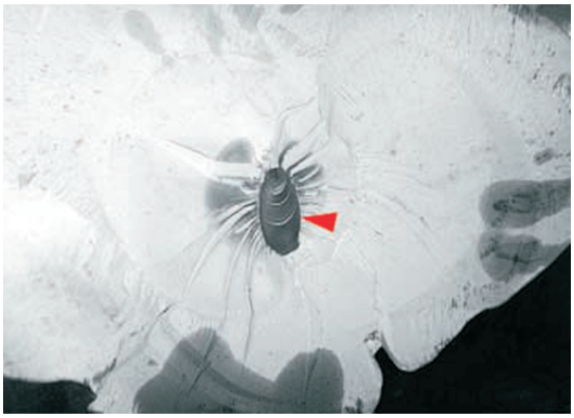
(3) Hydrogen Embrittlement :- Under inadequate supply of coolant, hydrogen is released due to decomposition of coolant lubricant, when temperature between roll surface and stripe becomes high. This hydrogen is picked up by roll surface where structure is martensite.

(4) Heat produced by local overloads :-
During cold rolling, high pressure load and high temperature can be caused by

a. Skidding during rolling.
B. Strip Rupture
c. Inadequate Coiler tension
d. Foreign bodies in roll gap
e. Annealing residue on strip
f. Sudden stoppage of mill under Hydraulic/ Screw down pressure.
g. Folding/pinching/doubling of strip during rolling .
h. Work hardening.
i. Excessive body end pressure.

Spalling is usually found in the highest contact pressure between work and back up rolls. It is desirable to provide uniform contact pressure distribution across the face of the roll. However due to factors like mill design, roll wear, chamfers, mechanical crowns, thermal crowns, roll bending pressure is generally not uniform.

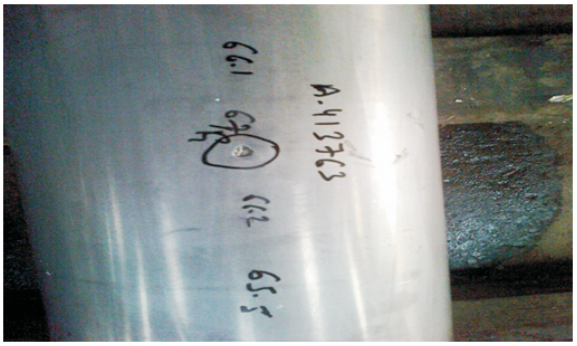
(5) Surface Spalling with fatigue path. :- It is the circumferential path that can be seen on back of surface. It can be seen from some inches to complete lap around the roll circumference. The initiation of fatigue path is opposite to direction of rolling. It can get generated from fine cracks, surface defects and high points of stress concentration. Cracking propagates radially and circumferentially to the transition zone of roll.



FATIGUE PATH SEEN ON ROLL SURFACE AFTER SPALLING OCCURRED

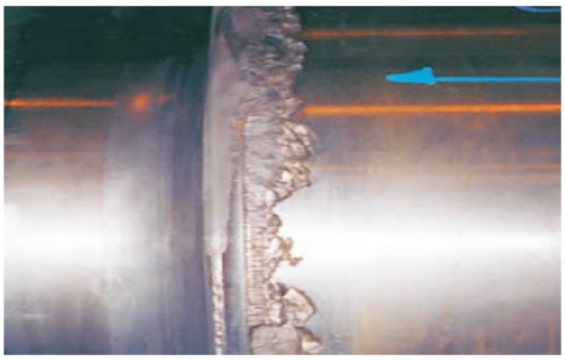
(6) Microspalling :-

Microspalling is due to thermal gradients which are in network pattern can generate due to sticking of material, slippage, pinching or grinding defect. The rise in temperature changes microstructure generating stress in the material. These stresses relax with formation of cracks with time.



(7) Contact Stress Fatigue :- Under mill load and localized flattening, roll material exceeds compression stress at sub surface locations. Cracks initiate and propagate below the roll surface .

This can occur instantaneously due to material wrap, skid, sudden stoppage of mill under load. Due to cyclic load of mill also, spalling results. In back up rolls it can commonly occur even without mill accidents. This usually occurs at contact point between work and back up rolls, strip edge and work roll body edge.

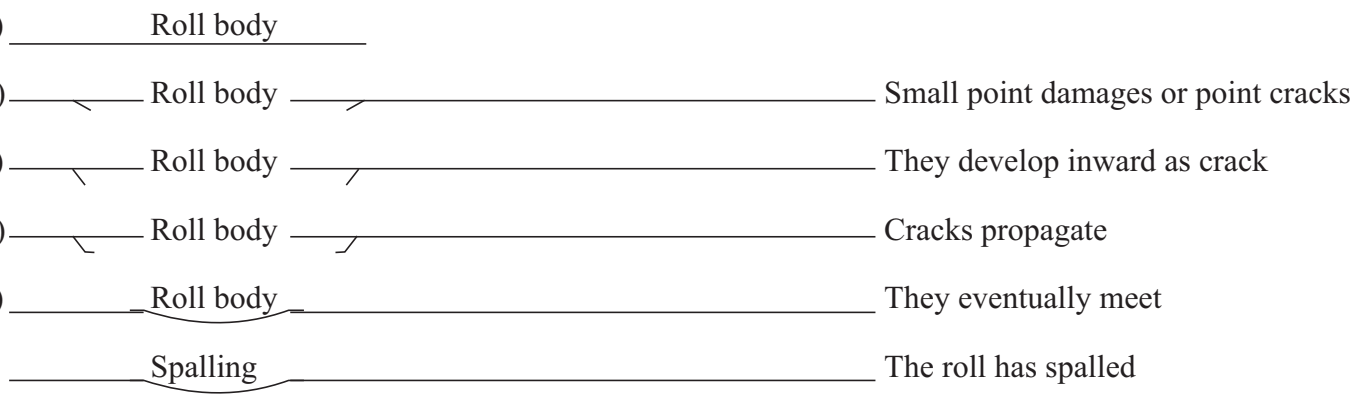


BODY EDGE SPALL INITIATING FROM CHAMFER OR BEVEL OF ROLL.

(8) Inappropriate hardness :-

Roll damage can sometimes be avoided by careful matching of hardness to rolling condition/material being rolled. Extreme high hardness rolls must be avoided with strong grades to be rolled, as such rolls are highly prone to damage. Also rolls with lesser hardness give short life and poor surface quality of product rolled. Pronounced strain hardening, which is not completely removed by grinding, also leads to spalling.

DEVELOPMENT OF SPALLING



Notes : (I) In case the cracks propagate towards each other (as shown in the sketch), they result in a big spalling.

(II) In case the cracks propagate in opposite direction to each other, they result in two small chipping just below the roll body surface. These discontinuities widen under rolling-pressure in a circumferential direction.

It must always be remembered that the spalling originates from small incipient cracks or fractures on or just below the roll body surface.

Fatigue fracture occurs and sooner or later the spall appears on the roll surface.

"Spalling" is the eventual major failure of a roll surface leading to the roll being rendered in most cases as useless; although its origin may be in a apparently small and insignificant surface flaw.

"Spalling" is not a spontaneous process, by taking precaution it could be minimised.

HOW TO AVOID SPALLING -

is a difficult advise to make, still one should take care of the following :

- Coolant should be sufficient and should be of good quality, while regrinding.
- Whenever strip breaks or skids, roll should be checked for damage with the help of magnifying glass / 3-5% HNO_3, solution.
- Stress relieving should be done for 4 hrs. at 160 ^{o}C/ 180 ^{o}C/ after 3 or 4 regrindings.
- Sufficient stock removal is recommended to remove work hardened layer. Hardness should be brought back to original level.
- Strict physical examination of every roll should be done after taking them out.
- Die penetration testing / ultrasonic testing / eddy current testing to be performed to ensure that the rolls going into next campaign is free from defects.
- Check hardness of every roll before and after use, work hardening should not be more than 2 HRC.
- For regrinding of skin pass mill rolls, resin or shellac bonded wheel is recommended to avoid chattering and micro-cracks.