STUDY ON THE MECHANICAL SYSTEM WEAR TYPES OF THE HOT STRIP ROLLING LINE

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ABSTRACT
This paperwork is considered the first stage of a large study about a hot strip rolling mill reliability. Some components of the main subassemblies are analysed for a rolling line as: stands, gear driving, adjustment system of the rolls, coiler. For these components the wear types are identified specifying the reasons that brought about.

KEYWORDS: hot rolling, types of wear.

1. INTRODUCTION
Rolling lines are complex mechanical systems, for which the optimum operation means the assurance of the material plastic deformation respecting the technological parameters to get a suitable product quality on one side and the operation of all subassemblies and equipment from the line composition on the other side, that means the complete achievement of the performance (capability or fidelity) the assurance of the given operation durability (the durability), the possibility of the partial or total replace (maintenance) the conservation of the operation characteristics in the preserving condition (preservation).

Respecting all these requirements the respective system reliability will be assured [1].

In the present condition the operation assurance of a system (in this case rolling line) requires the approaching of the new respects regarding: reliability, having in view the requirements of the up to date economy: new technologies for high quality products manufacturing; lowest consumption of the material, energy and fuel; environmental protection.

In case of the hot rolling mill, as first stage of the reliability study, the identification and analyses of the tearing shapes (wear) of the rolling mill stands subassemblies parts were imposed.

2. WEAR OF THE ROLLING LINE COMPONENTS

2.1 Wear types
Generally, the wear is defined as a material removed from the contact surface, in relative movement, plastic deformation and detachment with cavities (pitting) formation, respectively.

The main reason of the wear process is mechanical movement to which the relative movement type (slipping, rolling, impact etc.) is joined.

Thus the following wear types are considered:
abrasive wear, thermal wear, pitting wear, corrosion, cavity wear.

Heaving in view all these aspects, this paperwork shows the driving mechanism of the some rolling line subassemblies, construction and main wear types of the constitutive elements in correlation to their operation way and part played in the respective subassembly framework.

2.2. The characteristics of the main rolling line subassemblies
Hot strip rolling mill is manufacturing 1, 2...12 mm thickness strip coils. It is a continuous rolling mill type consisting oh two train of stands, a rougher with two descaling stands: vertical and horizontal ones, 5 universal roughing stands, 7 finishing stands, horizontal quarto with continuous operation and 30 35 m/s rolling speed of the last stand
-a water spraying cooling installation after rolling;
-3 coilers for strip rolled coils.

The general drawing of the 1700 mm hot rolling mill is shown in fig 1 [2]

In the present paperwork, the roughing stand and coiler subassemblies were analysed [3].
a) Roughing stand (fig. 2) is universal-quarto type.

The working rolls are backing up on the conical roll-bearings with liquid friction Morgoil type.
Backup roll-bearings are oiled with special installation oil and working roll-bearings are oiled with centralised installation grease.
Fig. 1. The drawing of the continuous hot strip rolling mill of 1700 mm.
1 - pusher type strip heating furnaces; 2 - roller track table; 3 - descaling duo vertical stand; 4 - descaling duo horizontal stand; 5 - universal quarto stands (rolling stand train); 6 - intermediary roller track table; 7 - flying shears; 8 - descaling duo stand; 9 - quarto stand (continuous finishing train); 10 - cooling installation; 11 - strip coilers.

Driving device consist of an electrical engine of 7500 kW on the plain (friction) bearing:
- main couplings for rotation transmission frame reducing gear to the pinion (driving) stand and from the engine to the reducer. Both couplings are geared type, normally or extended clothing. The oiling is made by the oil bath;

![Diagram](image1.png)

Fig. 2. Roller line
1 - working roll; 2 - coupling bar; 3 - gear stand; 4 - main coupling; 5 - reducer; 6 - engine coupling; 7 - engine.

-TD2-420 type reducer has 2 pinion (driving) steps with cylindrical gears, with straight and inclined teeth. Gear shafts are backing up on the conical roller bearings fitted on the case and metallic frame. The gears and bearings oiling is made with circulated oil;
- pinion stand for the driving and synchronised running of the horizontal stand rolls. It consists of two V toothed rolls. The gear is oiled with circulated oil;
- coupling bars convey the rotation movement from pinion (driving) stand to the working rolls of the horizontal stand and it assures the vertically adjustment of the rolls.

The bars are universal joint types of hydraulic calibration of the upper bar and spring for the down bar. The joints are bronze blades or bushes and calibration bearings are made of textolite. The joint oiling is manually made and of the bearings by water and grease.

Screw-down mechanism for distance adjustment between rolls, is a pressure screw type driven by an h horizontal axis electrical engine, by a cylindrical gear reducer and by a snailing gear (fig. 3).

![Diagram](image2.png)

Fig. 3. Mechanical system for horizontal roll adjustment.
1 - electro-engines; 2 - gears; 3 - conical roller bearings; 4 - reducer (V toothed gear); 5 - snail; 6 - snail gear; 7 - ball bearing; 8 - control instrument; 9 - elastic coupling; 10 - ball bearing; 11 - Selsin; 12 - elastic coupling; 13 - electromagnetic coupling.

For parallelism roll adjustment, the gear mechanism of each screw could be cut by an electromagnetic coupling fitted between those two electrical engines.

b) Vertical stand is duo type placed in front of the horizontal stand (fig. 4).

The driving is made by two vertical axis electrical engines placed on the upper side platform of the horizontal stand. The rolls are in console fitted on the shaft backing up on two sided conical roll-bearings.
The coupling bars are telescopic types with cardan joint and conical roller bearing. Reducers are cylindrical gears, with vertical axis, being synchronised with an intermediary gear. The vertical rolls are each pressed by two screw-downs and hydraulic balanced.

2.3. Wear types of the stand and coiler devices

At the beginning of this paperwork I have emphasised that no systematic study was made up to now, regarding the wear and reasons of damages and out-of-operation of the mechanical systems and of the rolling-mill subassemblies elements.

The only estimation way of the device operation span is the following:
- the items which are in direct contact with the rolling material (rolls, rollers, cooling spray nozzle) are changed periodically in base of some measurements, of experience or of norms in full force and effect;
- the items which are not in contact with the material (gears, adjustment, balancing etc) are changed in case of the accidentally damages (breaking, explosion, blocking etc).

The present paperwork, an identification of the wear shapes of the constructive elements was made in correlation to the working conditions.

a) Rolling stand
- abrasive wear: working roll barrel, due to the contact with the movement material; plain (friction) bearings, Morgoil bearings of the backup roll neck;
- thermal wear: working roll barrel due to rolling material, coupling bar point;
- pitting: coupling gears, reducers, gear stands, roll bearings due to oiling conditions;
- fatigue: roll neck (journals) due to the uneven rolling strain stress, high rolling power, coupling bar points which have not an uniform rotation movement (due to alternating time of operation-down-time);
- oxidation: plain (friction) bearings, Morgoil bearings due to the contact with oil, moisture and dust;
- lamination (spalling): may appear at gears;
- friction wear: due to slipping friction backup rolls that are driven by the contact with working rolls;
- cavities, corrosion: cooling water spray nozzles, due to water contact, in high-speed movement and to the steam during rolling operation.

b) Adjustment devices of the rolls
- abrasive wear: gears, reducer gears, elastic couplings, electro-engines shafts, snail snailwheel, screw-nut / screw-down;
- pitting: roll-bearings, reducers-gears, gear coupling;
- fatigue: gear coupling, snail-snailwheel, elastic coupling;
- friction (of slipping): pressure screw-nut / screw-down;
- blocking due to atmosphere dust: synchronisation, electro-magnetic couplings.

c) Coiler

- abrasive wear: cylindrical toothed toothed gears of the hydraulic system: driven rollers bearing, forming rollers due to coiling material contact the drum on which the strip is coiled, due to friction during expanding and contracting, gear coupling;
- friction (slipping): roll bearings of the guiding device and hydraulic system;
- pitting: roll bearings, cylindrical toothed gears, driven roller bearings, drum segments due to grease contact;
- fatigue: bearings, screws of the expanding-compression system, drum shaft, forming roller couplings;
- cavity, corrosion: hydraulic cylinders of the adjustment system.

Besides of all these wear shapes, permanently the plat atmosphere dust, steam due to cooling of rolling rolls, to rolled material and of the other components, strong vibrations of the rolling stand due to rolling impact are added.

3. CONCLUSIONS

From this paperwork resulted the following remarks:
- all the rolling line components are submitted to different shapes of wear, prevailing abrasion, pitting and thermal wear;
- wear types are in tight correlation to working condition and operation condition of the equipment, reality that hasn’t been studied up to now;
- wear condition of the equipment (except rolling rolls) may lead to some damages to rolled products, also, this aspect was very little studied up to present.

The researches regarding wear process and its control way is developed into a study program of the system reliability.

REFERENCES