1. Introduction

The problem of fatigue damages caused by the rolling contact became more and more important on the network of Hungarian Railways during the last years. Some years ago there were only few or even no head-cracks (Head-Checking, abbreviated HC) observed. Today the authorised persons have to deal a lot with the idea of head-checks especially on the Budapest- Hegyeshalom railway line.

2. More about Head-checks

Under the fatigue damages and head-checks (HC) caused by the rolling contact those crack forming in the rail head should be understood which develop due to the effect of great sliding forces (especially the high longitudinal sliding forces due to the material displacements close to the surface. These damages occur mainly in curves with radii between 300 m and 3000 m on the running edge of the high rail.

Calculations prove that even small changes in the shape of rail (or wheel) can have a great effect on the contact stresses between them, and the high contact stresses facilitate the rolling contact fatigue.

This explains why the crack prevails in curves and in turnouts without rail-inclination. The radius of a new rail head becomes gradually smaller as we move from the rail crown to the gauge corner. If a vehicle moves straight it is ready to run down from the mid-point of the rail head where the radius of the railhead is great. Similarly the wheel usually moves on the middle of wheel tread, hence the contact stresses are generally small.

In the present situation our main focus is on the keeping of operation safety.

The fatigue rail damages caused by the rolling contact evolve in a larger and larger measure and cause significant damages to railway companies.

The detailed learning of forming and cause of rail fatigue damages means a great challenge for the experts.

The formation of HC in turnouts corresponds to the formation in tracks in the following parameters:

- Head-Checks form to a great extent in those places which are subject to greater (longitudinal) sliding forces (great longitudinal slope, track sections of acceleration),
- Head-Checks occur to a greater extent at higher operational load,
- Turnouts in curves damage stronger then the turnouts in straight track.

Fatigue originating from rolling contact in turnouts every how occurs earlier than in plain track. The reason of this is that the wheel/rail contact occurs earlier on the running edge.
The wheel/rail contact surface in turnouts due to the missing rail inclination occurs even in the new state between the edge and the centre of the railhead. The small-scale change of the cross-section of the railhead (cold strain caused by the loading at the transition) moves the wheel/rail contact surface forward the edge of the railhead. Hence the inclination grows to the forming of rolling contact fatigue phenomena (HC). Hence head-checks are formed stronger in turnouts than in straight line sections in plain tracks.

It is very important to learn:

- The process of development of endurance and damaged rail faults caused by rolling contact. With increasing the axle loads the rail/wheel interaction should be analysed
- Precise mapping the sites of development of fatigue rail faults. According to the experiences till now the damages occurred mostly in curves and turnouts.
- The types of development of fatigue rail faults.
  - Rail head-checking
  - Rail head flattening (SQUAT)
  - Belgrospi
  - Tongue forming
- Presentation of the examination methods of fatigue rail faults.
  - Visual examination
  - Eddy current examination
    - By manual Eddy current instrument
    - Mechanical measuring equipment mounted on a measuring train
      - Ultrasonic examination
- Qualification of measuring results
  - From operational safety point of view
  - For the determination of the necessary maintenance work
- Prevention possibilities of the forming of fatigue rail faults
  - Selection of the material of rails
  - Producing the appropriate profile by rail grinding
  - Preventive rail grinding
- The technology of cessation of the faults developed
  - Rail grinding,
  - Rail milling

There are still a lot of open questions, for which we are looking for the answers in the near future!

Some of them:

- How do the cracks start and grow?
- What is the effect of the class (grade), metallurgy and micro-structure of the rail material on the formation and growing of fatigue rail faults?
- Does the white etching layer (we can find sometimes on the top of the rail) play any role in the start and growing of squats?
- What is the relationship between the wave sample caused by squats and the short-pitch rail corrugation?

3. References

[1] RAILTRACK PLC, Rolling contact fatigue in rails; A guide to current understanding and practice, RT/WG/001 Issue 1 (February 2001)