Relevance of a Defect free Rail condition after Rail Maintenance

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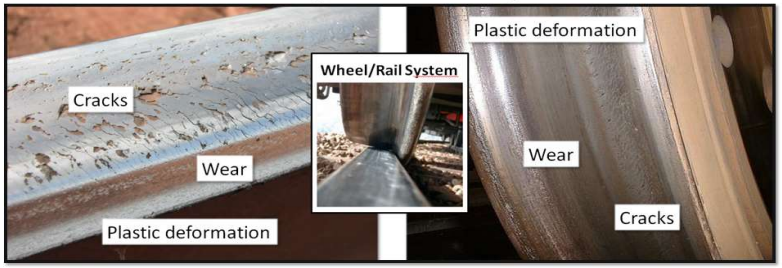
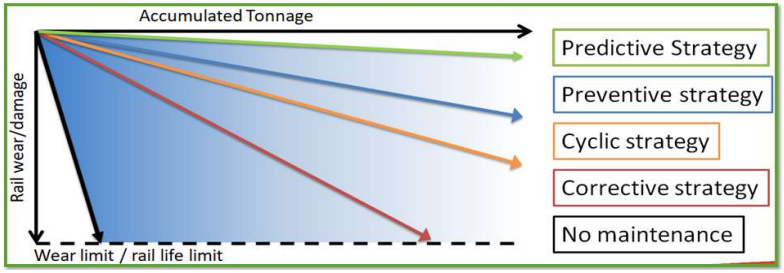
Rolling contact fatigue

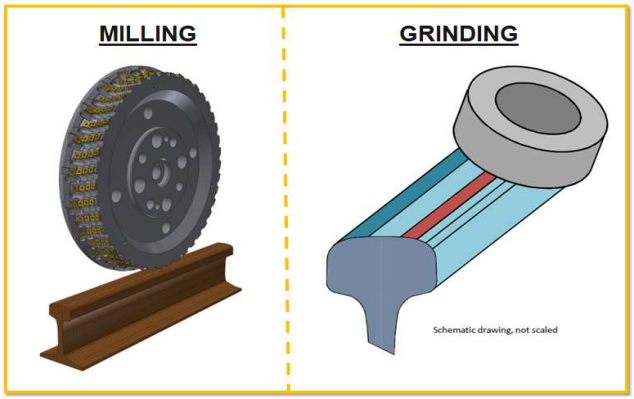


Maintenance strategies



Circle of rail life

Maintenance technology



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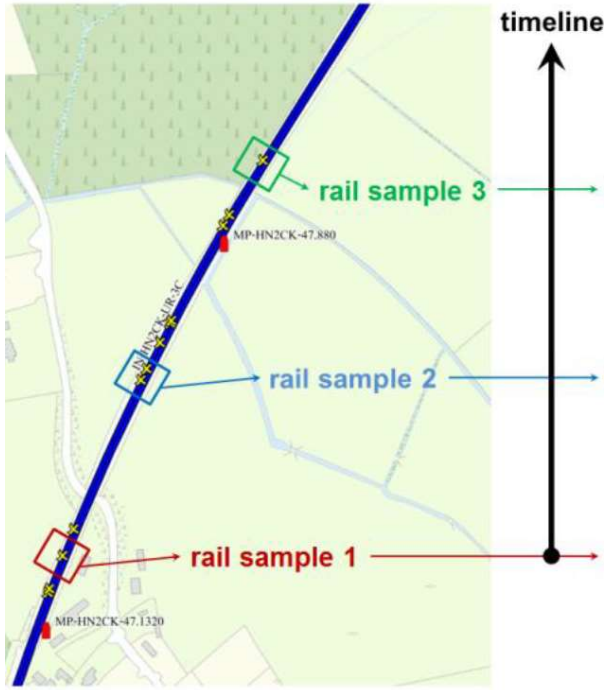
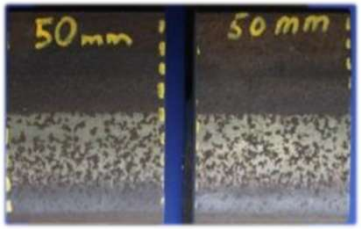


Erkenntnisse zu optimierten Frässtrategien



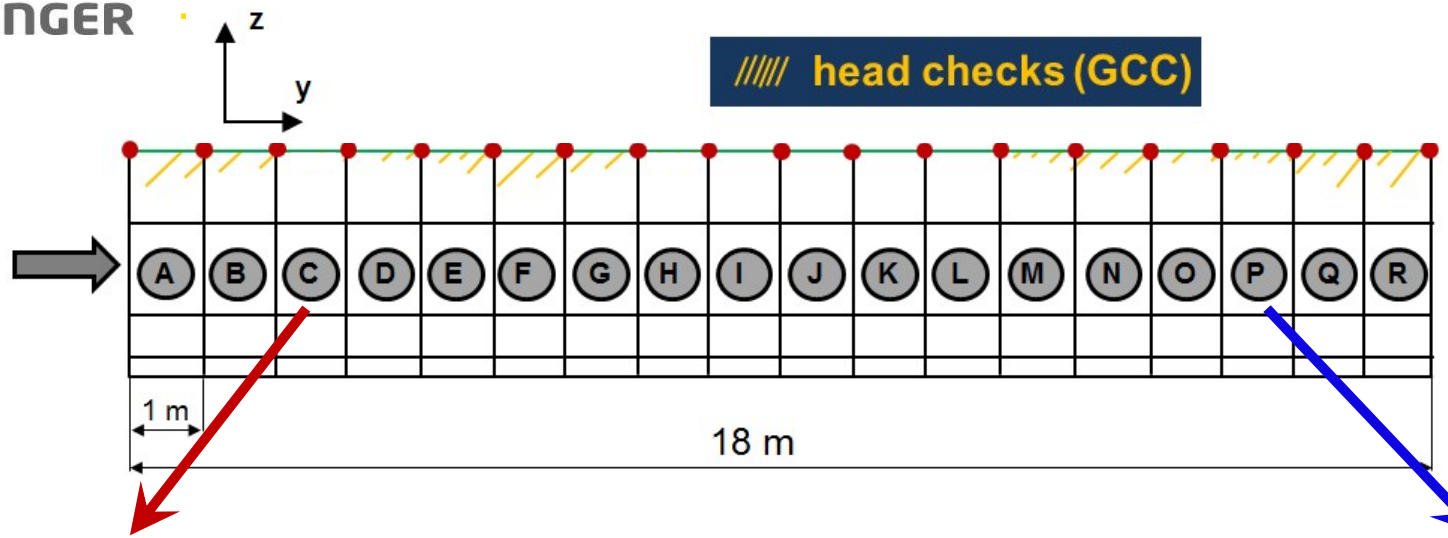
Änderung des Facettenbildes

7 months
(≈ 2.30 MGT)

11 days
(≈ 0.12 MGT)

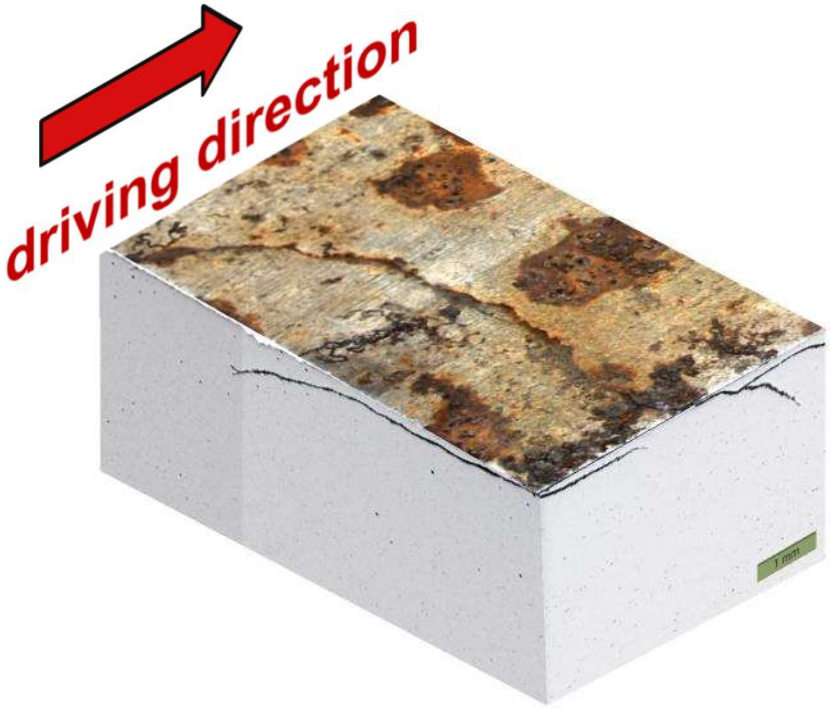
reference sample (non maintained)

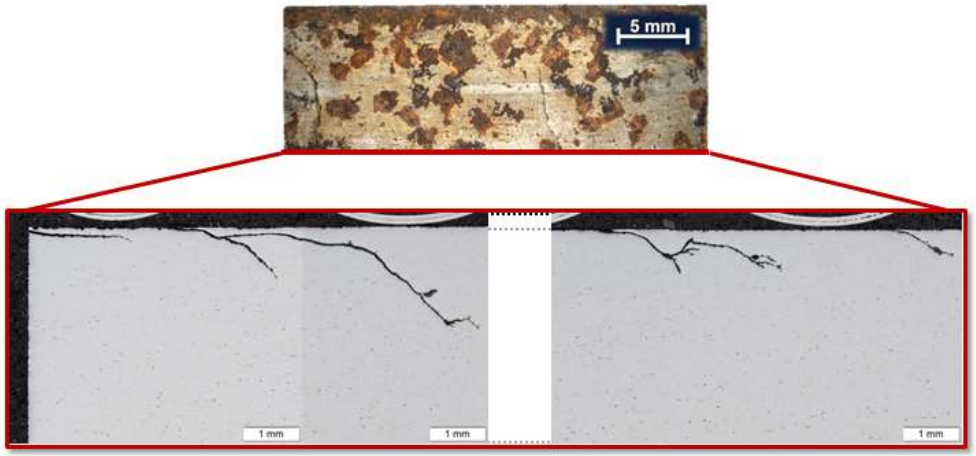
0

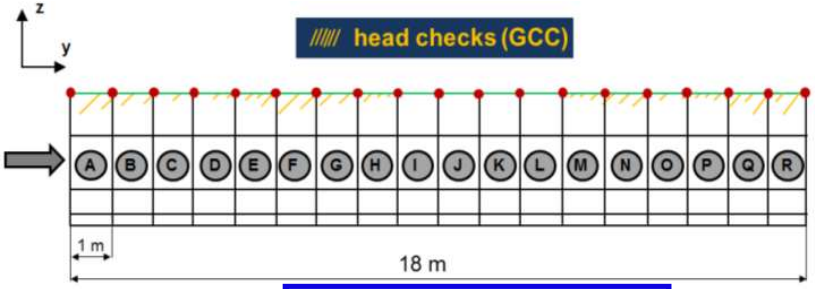


Sample without cracks

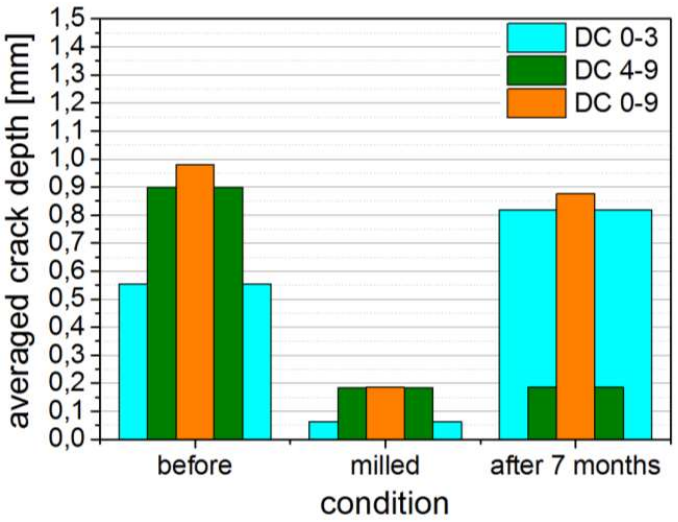
Sample with various crack length


driving direction
1 mm


5 mm
1 mm
1 mm
1 mm



METER	MAX (DC 0-3)	MAX (DC 4-9)	MAX (DC 0-9)
0,00	0,45	0,44	0,45
0,98	0	0	0
1,98	0	0,51	0,51
2,97	0,32	0,45	0,45
3,97	0,52	0,85	0,85
4,96	0	0,79	0,79
5,95	0	3,24	3,24
6,94	0	1,37	1,37
7,93	0	0,38	0,38
8,92	0	0	0
9,91	0	0	0
10,90	0	0	0
11,89	1,78	0,94	1,78
12,88	1,98	1,73	1,98
13,87	0,26	1,32	1,32
14,86	0,59	0,9	0,9
15,85	0,97	0,83	0,97
16,84	2,19	1,91	2,19
17,83	1,45	1,44	1,45
average value:	0,553	0,900	0,981



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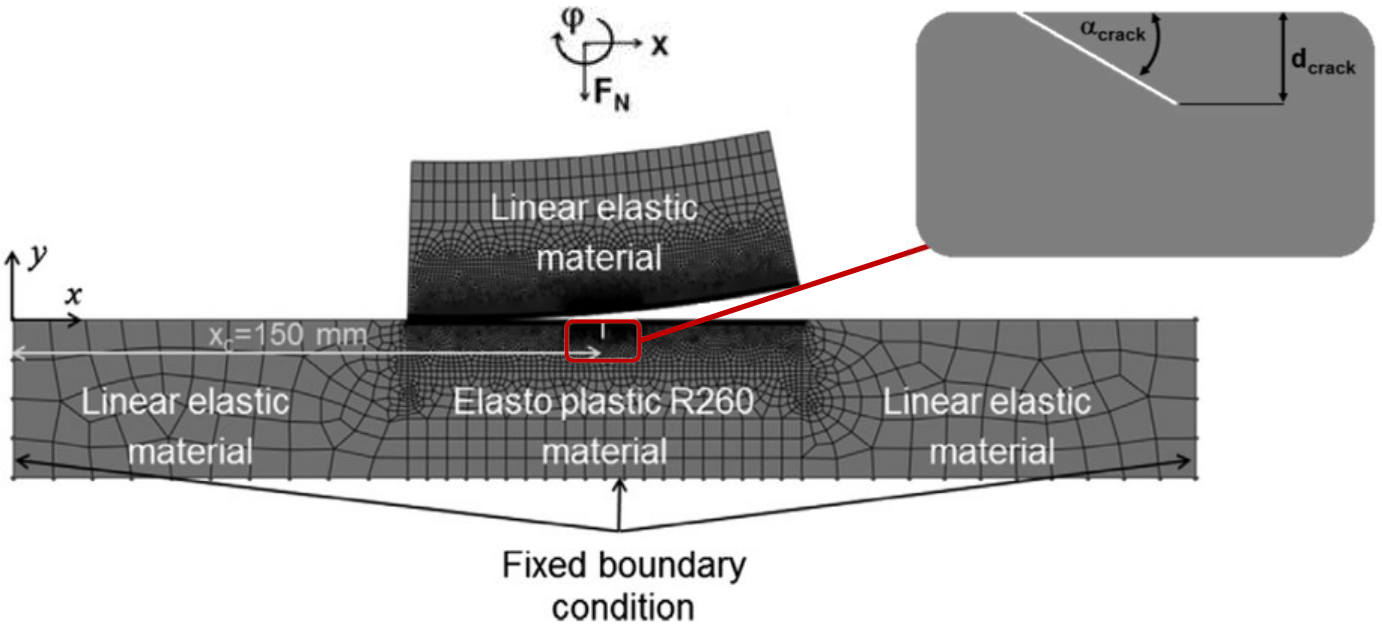
Engineering Fracture Mechanics

Calculation of crack driving forces of surface cracks subjected to rolling/sliding contact

M. Kráčalík[a,*], W. Daves[a,b], T. Antretter[b]



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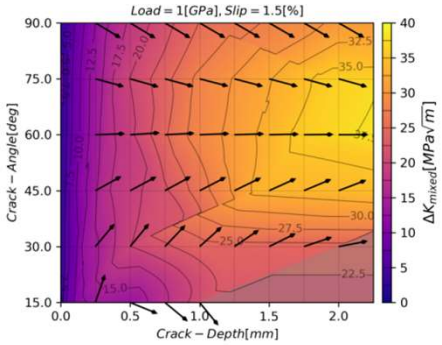
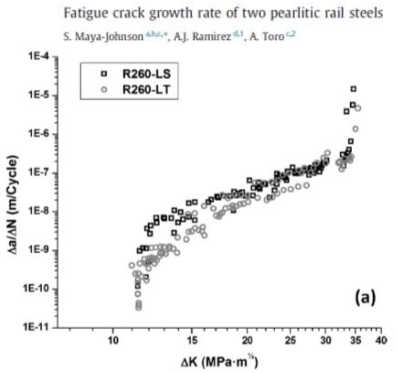
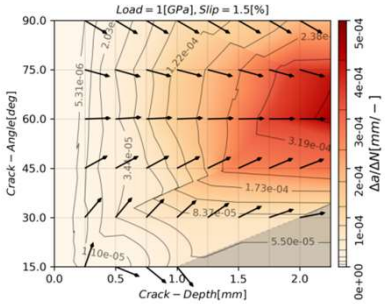


$$\frac{\Delta a}{\Delta N} = C \cdot \Delta K^m$$

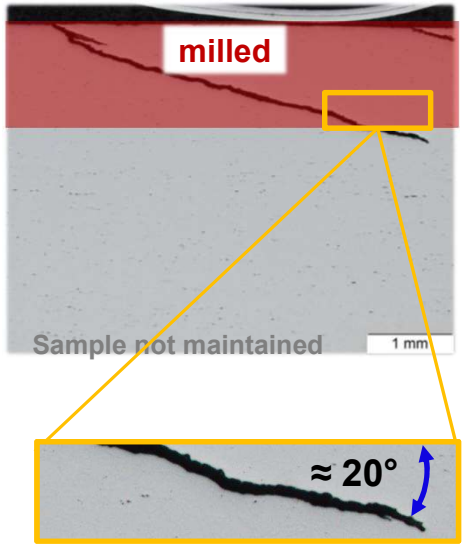


m = 3,9781 | C = 2,30 e-13

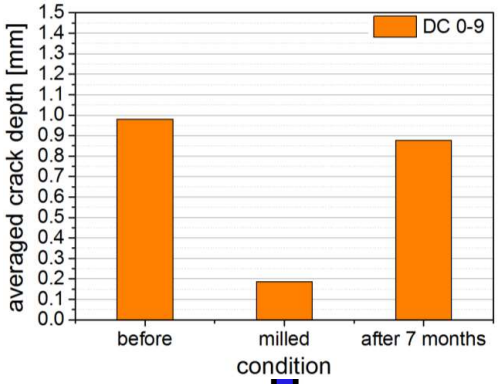
By using published crack growth curves for rail steel grades, it is possible to convert the calculated stress intensity factor *ΔK* to a crack growth/cycle *da/dN*.



measured crack angle

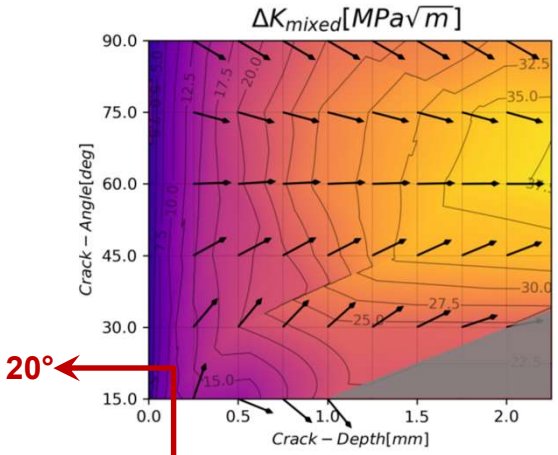


averaged crack length



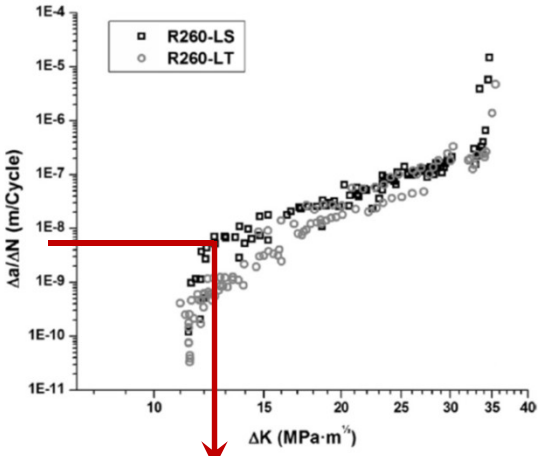
$d_{crack} \approx 180\ \mu m$

On the basis of not maintained rails and their measured & averaged crack depths, the initial conditions for the crack growth calculation can be defined.



20°

0.18 mm



12,25 MPa√m

$\Delta K \approx 12{,}25\ MPa\sqrt{m}$

$$\frac{da}{dN} \approx 4.90 * 10^{-06}\ mm/cycle$$

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Calculation

$$N_{max} = \frac{\text{averaged traffic load}}{\text{wheel load}}$$

$$N_{max} = 287{,}500 \text{ rolling cycles}$$

$$\Delta d_{crack} = \frac{da}{dN} * N_{max} * \sin(\alpha_{head\ check})$$

$$\Delta d_{crack} = 704\ \mu m$$

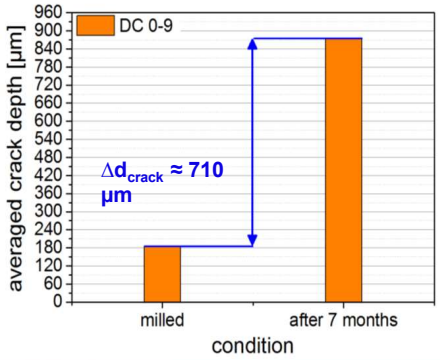
Assumption:

averaged traffic load= 2.30 MGT (Infrastructure manager)

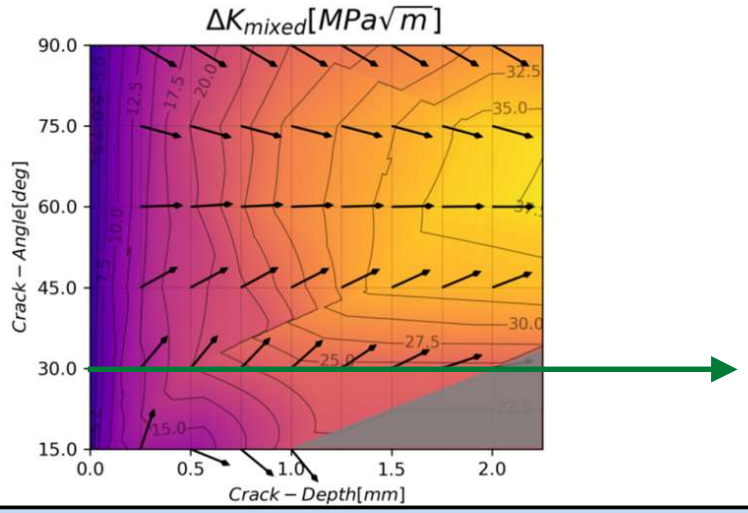
wheel load = 8 t (local train traffic)

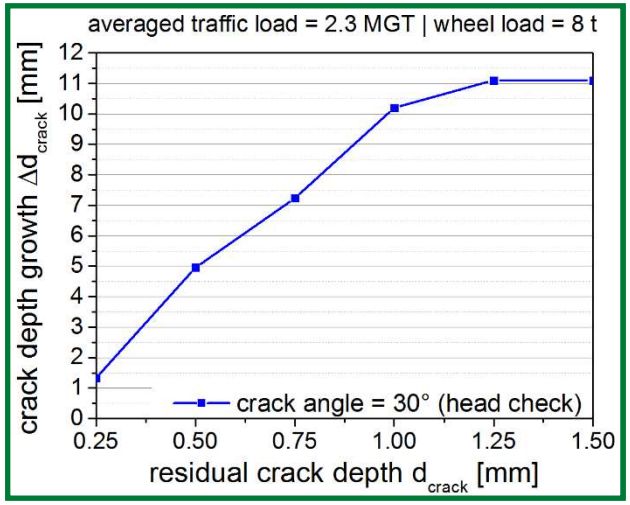
$\alpha_{head\ check}$ = 30° (measurement)

Observation



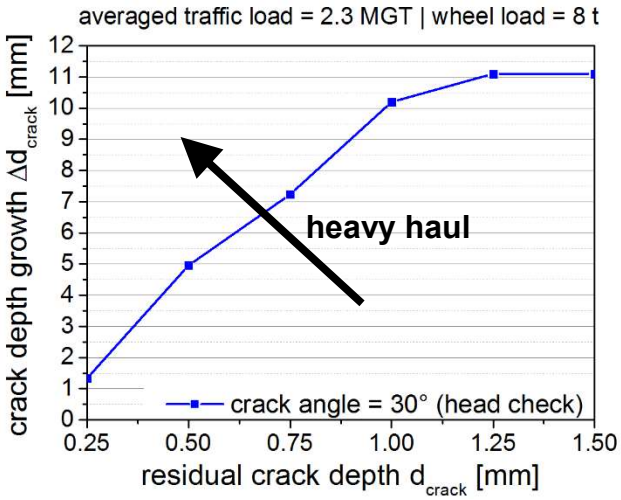
Excellent Agreement between the averaged measurement and the predictive maintenance simulation tool.

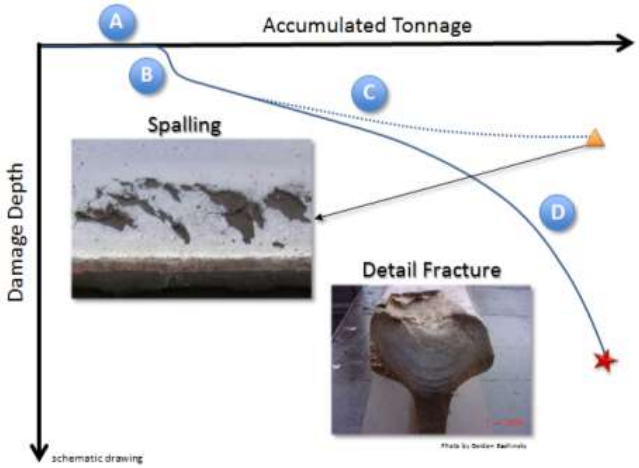




crack depth growth can vary in a wide range (non-linear) & depending on a great many influence factors as such:

- **crack length**
- **crack angle**
- **load situation (contact pressure & slip rate)**





„Residual cracks“ should be removed completely otherwise the situation is unmanageable.

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Wilhelm Kubin
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QUALIFICATIONS: (Degrees, University/College, Subject) Dipl.-Ing Dr. mont., Montanuniversity Leoben, Mechanical Engineering – Mining/ Material science

BRIEF CAREER SUMMARY:

2006 – 2015: Diploma study at the Montanuniversity Leoben, Austria Diploma thesis: Prediction of squats due to defects at the border of the running band of a rail head

2009 – 2015: Student assistant at the Materials Center Leoben Forschung GmbH Topic: Rolling contact fatigue and the influence of surface roughness

2016 – 2019: PhD student at the Materials Center Leoben Forschung GmbH in cooperation with Linsinger and LINMAG
Topic: Scientific research of rail milling

2019 – now: R&D / Deputy of the technical head of the tool department at Linsinger Maschinenbau GmbH

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Thank you for your attention!