

WASTEWATER DRAIN NETWORK – SHUTTER FLAPS CRANE RUNNER WHEELS IN SUPER DUPLEX FORGINGS – SYSTEMS IN SINGAPORE

Forgings in various big dimensions with
extreme tight Hardness Tolerances

Materials Engineer & Consultant

Dipl.-Ing. Rolf Kirchheiner ☎ +49 170 5532778 ✉ r.kirchheiner@material-expert.com

Challenges and Questions:Part 1

A global acting German company in designing large wastewater systems has been tasked since 2017 with creating a failsafe shutdown system .

That system can handle extreme flooding volumes of municipal wastewater in Asia (*). Lifetime to be guaranteed = 100 Years !

(*) 600.000 m³ per day
in Singapore



Challenges and Questions - Part 2

Is it ever possible to design the required parts for the heavily loaded shutdown system in corrosion- and wear-resistant stainless steels?

First questions arrived at HEMPEL in August 2021. The Customer at that time did not reveal the background. My first estimate looking at the analysis of the heavily polluted wastewater, led to the conclusion: Customers' choice for a soft-martensitic Stainless Steel (1.4313) is wrong!



Challenges and Questions - Part 3

In 2022 our customer revealed a new combination

Crane Runner Wheels in
Super-Duplex (1.4501) and
Crane Runner Rails in Super-Austenite
(1.4529)

Extreme tight tolerances for the Hardness Values (HB) were specified for the Super-Duplex Forgings; e.g. 250 HB plus 10 HB absolut

- Randomly picked PREN- Values (22) were specified for Corrosion Resistance.?

No European supplier of raw forgings was prepared to deliver acc. to that specification; they all claimed 25 HBplus Tolerance min.

Challenges and Questions – Part 3

Fail safe Shutdown
Gates in normal
operation;
no critical flooding
pressure from the
Ocean or Monsoon

Arrows point to the
Shutdown Gates in
Position „open“

Challenges are :
Flood Pressure
resistance & heavy
Corrosion



Portal Cranes for handling heavy loads on rail systems; runner wheels must perform at lower wear resistance than rails! Hardness must be limited therefore.

Reason: rapid exchange of wheels in case of damage; rails embedded in concrete cannot be exchanged



Case Story 1 – Super-Duplex Forgings for large Wastewater Shutting Systems in Singapore (Crane Runner Wheels)

Path to a Solution of the technical Problem – Parameters for Hardness Tolerance (HB)

Parameters affecting the Mechanical Properties – here: Hardness

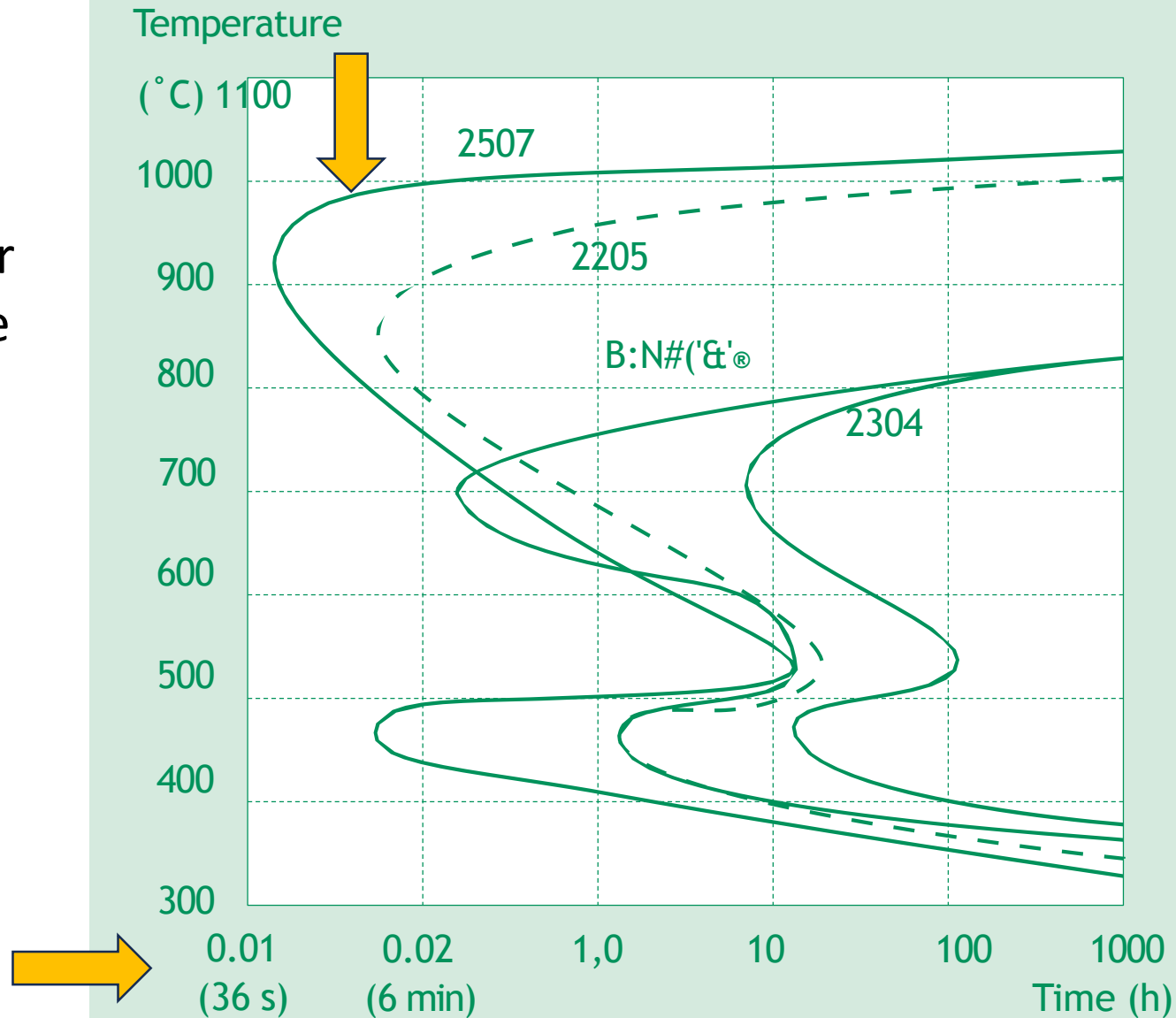
- (1) Chemical Composition of the Melt and raw Forging
- (2) Hot-Forging & Solution Annealing Temperatures & Cooling Cycles of the raw Forging
- (3) Cold Deformation of the Austenite (fcc) e.g. by Rolling & Chip Turning
- (4) Method of Hardness-Measurement (*) & Inspectors Background

(*) Hardness is a very local property to be measured at the surface of the forging only! Brinell Hardness (Ball) is capable averaging out the peak values compared to Vickers Hardness (Pyramid)



Parameter 2 – Temperature

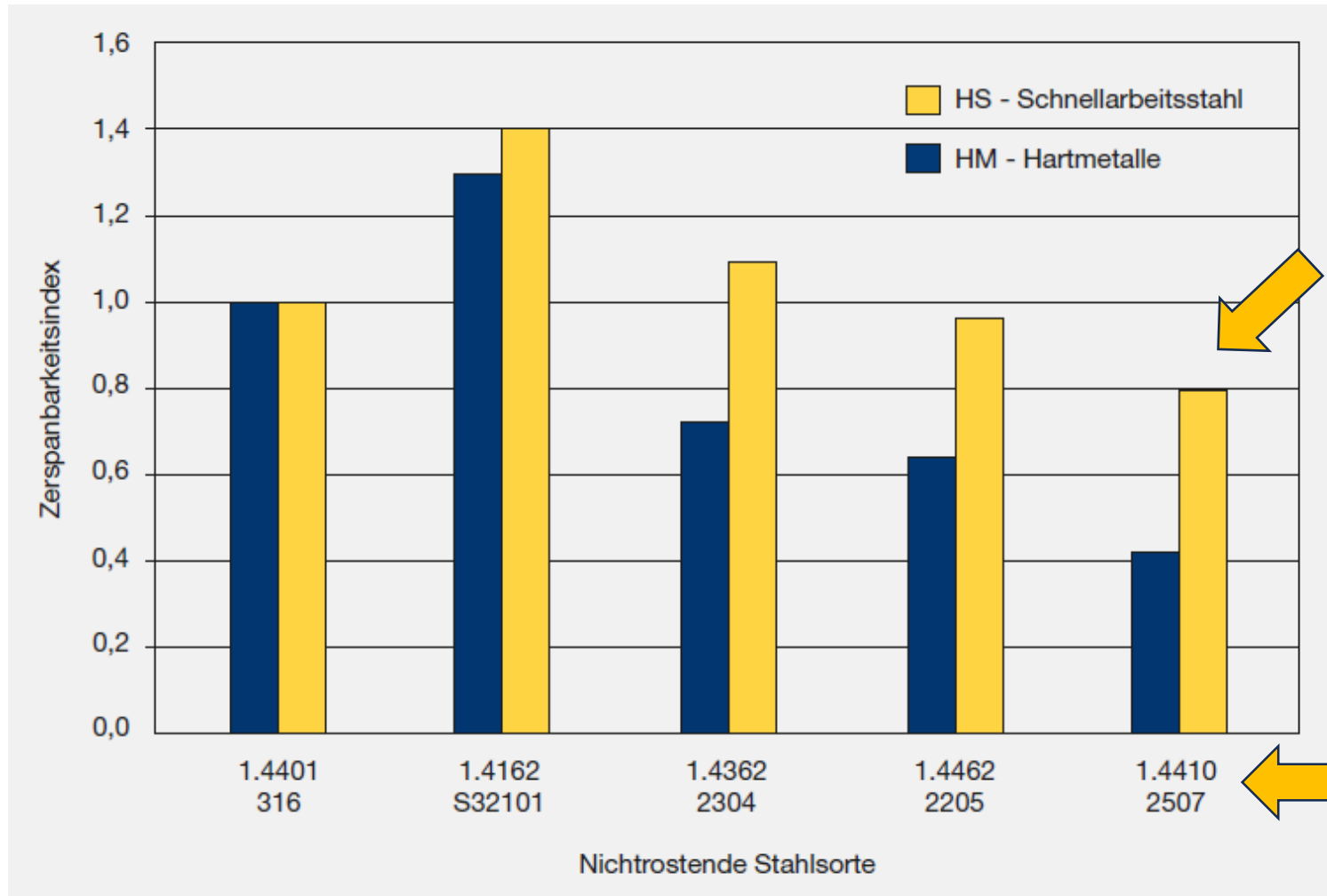
High Risk area for
a drastic increase
of Hardness for
Super-Duplex
2507 (14501);
loss of 50%
Impact
Toughness



Parameter 3

Cold
Deformation
increases
Hardness by
Dislocations;

2507 shows
the highest
sensitivity
(Machinability
Index)



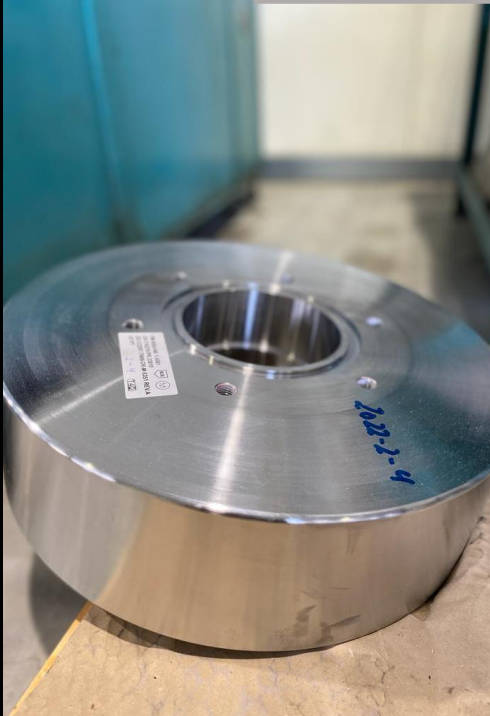
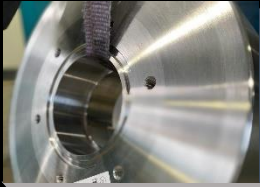
CASE STORY 1 > SUCCESS STORY

Just 3 out of 48
single values are
slightly out of the
range limits; all
values are accepted !

250HB + 10 HB abs =
max. 260HB

Nr./No.	1	2	3
2022-1-1	258	257	252
2022-1-2	250	251	259
2022-1-3	260	261	259
2022-1-4	258	255	257
2022-1-5	254	256	255
2022-1-6	254	255	258
2022-1-7	261	264	261
2022-1-8	258	259	255
2022-1-9	256	258	255
2022-1-10	258	254	255
2022-1-11	256	255	257
2022-1-12	254	257	258
2022-1-13	253	251	252
2022-1-14	251	255	258
2022-1-15	256	252	255
2022-1-16	251	255	254

**16 Wheels Forging acc Zg.-Nr.: 122207-TN00-DR-M-
5351, Rev. A**



CASE STORY 1 turns into a SUCCESS STORY

Total Count revealed more than
95% of all single values are
perfectly inside the range limits:
 $250\text{HB} + 10\text{ HB} = \text{max. } 260\text{HB}$

CASE STORIES TURN INTO SUCCESS STORIES

Ingredients & Prerequisites

- Collaboration across Company Borders
- Teamwork
- Data Mining using Human & Artificial-Intelligence
- Consulting & Coaching

Using case stories is an essential and effective way to generate ongoing & successful business results.

Tools for Success Stories inside the HEMPEL - Group

What are the secret ingredients?

