Switzerland and 400 UHC® HSH®: Customer benefits by improving material design

Colleagues *Julian Wiedorn* and *Oliver Fuchs* from voestalpine Rail Technology, a company of voestalpine Railway Systems Group, explain how the geographical typography of Switzerland has challenged the manufacturer to develop the 400 UHC® HSH® rail grade, offering a solution to the problems of rail deterioration caused by high loads within Switzerland and further afield.

Challenging Switzerland

Switzerland's unique and beautiful landscape of many lakes and mountains poses a considerable challenge for rail transport. Cities that are spaced far apart, as well as local neighbours, all have to be connected with each other, over long as well as shorter distances. For the railway and its infrastructure, especially for construction and operation, this means different geological conditions, tight curves and high gradients.

From a rail point of view, and also for the customer-oriented rail manufacturer, the last two points are particular important requirements: Tight curves and high gradients are known to cause high loads that are responsible for rail deterioration. To counteract this problem and, above all, these loads, voestalpine Rail Technology has developed the 400 UHC® HSH®.

Railways in Switzerland

The railway in Switzerland that connects most of the cities with one another is operated by the Swiss Federal Railway (SBB). Rural areas, but also special sections in urban areas, are supplied by railways who are part of the Association of Public Transport (VöV). More than 50 VöV railways exist in Switzerland. The geographical location explains the large number of different railways. At the same time, it defines important properties of these railways: many of their tracks are almost exclusively run in mountainous areas. Besides the typical narrow track gauge (1m instead of standard gauge 1.4m), curve radii smaller than 150m and inclinations higher than 20‰ increase the load on the infrastructure. With axle loads and speeds known from mixed traffic, sharp curves are now operated – radii that are more common in tram networks. This causes high wear and corrugation.

The results are low service lives, as well as increased noise and vibration. The latter is particularly unpleasant for people living close to rail lines, but also damaging for the remaining superstructure. The decisive factor here is the maintenance of the (optimum) new condition of the rail profiles. Besides, wear and corrugation problems concerning running behaviour will occur, which will influence the entire railway system. »

OLIVER FUCHS

Oliver has been Vice President of Sales since 2008 at voestalpine Rail Technology, part of voestalpine Railway Systems, and is commercially responsible for the VöV railways in Switzerland. Oliver joined voestalpine and has worked in previous positions after studying industrial engineering at the Vienna University of Technology.

FIGURE 1

Corrugation of different rail types: (a) 400 UHC® HSH®, (b) R350HT and (c) R260 at RhB.

In order to cope with increased loads in the railway industry, the 400 UHC® HSH® rail grade was developed and is widely used in different areas of Switzerland's rail network.

JULIAN WIEDORN

Julian is Product Manager for mixed traffic and is responsible for customers in Switzerland. He has been with voestalpine Rail Technology, part of voestalpine Railway Systems, since 2018 and before that earned his PhD in material science at the University of Leoben.

FIGURE 2

Construction site with typical sharp S-curve at Zentralbahn.

400 UHC® HSH®

In order to cope with increased loads in the railway industry, the 400 UHC® HSH® rail grade was developed and is widely used in different areas of Switzerland's rail network. It was introduced more than 20 years ago for heavy-haul transport[1], where it, and its successors, are now used as standard rail grades (approximately 300,000 tonnes from voestalpine Rail Technology), especially in Australia, South and North America and Africa. Furthermore, the rail grade is successfully used in mixed traffic[2,3] and metro application, even as standard in curves, i.e. ÖBB (Austrian railways) and Wiener Linien (Viennese Metro and Trams)[4].

The properties of the rail are determined by its material concept. Similar to its predecessor, the R350HT, the 400 UHC® HSH® is a fine pearlitic steel grade, but with an improved material design (using the HSH® heat treatment technology). This concept allows for a significantly increased resistance to typical rail damage, especially wear and corrugation, and is therefore known for the preservation of its (new) profile. The requirements of the VöV railway networks in Switzerland and the improved resistance to their prevailing rail damage, makes the rail perfect for these areas in track.

400 UHC® HSH® and Switzerland: A perfect fit?

High loads on the different networks of VöV operators (tight curves) have resulted in a need for better rails. Based on an optimised (error free) railway system, it is obvious we should follow this path by optimising the rail grade.

The VöV railroads in Switzerland therefore recognised the potential of the 400 UHC® HSH® in their network very early on. The success story started in 2012 with the SZU (Sihltal Zürich Uetliberg Bahn), a local railway in the vicinity of Zurich. The SZU saw its old R260s achieve a rail service life of only a few years, due to wear and corrugation. Together with consultants and voestalpine Rail Technology, the network was analysed and a first in-situ test in track begun, accompanied jointly by SZU and voestalpine Rail Technology through regular inspections. Comparison of the wear of the old (R260) and new rails[5] proved successful very early on. The predicted improvement of the service life of a factor of six was even exceeded, and the 400 UHC® HSH® is now used as standard.

Around the same time, a dialogue between RhB (Rhätische Bahn) and voestalpine Rail Technology began. Unlike SZU, RhB is located in the east of Switzerland and provides infrastructure for surrounding towns, mainly in mountainous regions. Due to the tight curves, however, similar problems arise for the railways, i.e. extreme corrugation. Through a cooperation, a demonstrator test was initiated that included not only the R260 rail grade, but also the R350HT grade, to investigate its differences. Significant improvement was achieved with the rail grade 400 UHC® HSH® compared to R350HT and R260 (see Figure 1). This result laid the foundation for further applications of the 400 UHC® HSH® – up to standard use and a long-term partnership.

Other railroads with similar network characteristics to the RhB network followed, i.e. MGB, MOB and Zentralbahn. In most cases, a solution and demonstrator scheme was designed together. Of particular interest, however, is the recent installation at Zentralbahn (see Figure 2). They suffered from heavily worn rails and wheel flange contact. With a supporting lifecycle costs (LCC) calculation, it was possible to show the potential of the rail grade 400 UHC® HSH® up to a single rail strategy. In order to exploit this potential, the problem of wear and wheel flange contact (rail/wheel contact analysis), as well as the topics of profile stability and maintenance, were worked out together in advance. The initial installation took place and the 400 UHC® HSH® strategy is in the start-up phase.

Summary

It turns out that voestalpine's 400 UHC® HSH® is an ideal product for the requirements of VöV railways in Switzerland. Many installations in track with different operators confirm the successful and proven application.

Furthermore, we have been able to determine how important planning and consultations are, especially when introducing a super premium rail grade. The joint projects helped to analyse differences of the individual networks and develop adapted solutions, for, and with, customers.
The use of a high-strength rail grade is a significant change – and different for each operator.
The following interconnected points have proven to be particularly important:

- Technical system response: A new rail grade changes the system. For example, the 400 UHC® HSH® shows little wear and keeps its profile. Poor profile pairings must be avoided.
- Maintenance concept: The performance of the rail improves. In case of wear, this means less maintenance and longer intervals.
- Observation: In order to control and optimise the previously planned system, an observation period should be accounted for in which the system or maintenance concept may be adjusted.

voestalpine Rail Technology expects an increasing interest in 400 UHC® HSH® rails and is looking forward for further projects to prove their benefits, especially in the area of VöV railways. This way we can create additional value for all our customers suffering similar problems. Thus, the 400 UHC® HSH® fits in perfectly with the numerous customer solutions offered by voestalpine Railway Systems, where it is also used as a component for complex system approaches.

For more information, visit:
www.voestalpine.com/railway-systems

@GlobalRailway

REFERENCES

1. Robles Hernandez F C, LoPresti J., Interim evaluation of premium rail steels at FAST, Technology Digest 2007 (2007).
2. G. Girsch, A. Joerg, W. Schoech, Managing Rail Life to Match Performance and Cut Costs, Railway Gazette International 166 (2010) pp 45-48.
3. G. Girsch, R. Heyder, N. Kumpfmueller, R. Belz, Comparing the life-cycle costs of standard and head-hardened rail, Railway Gazette International (2005) 549–551.
4. Thomas Hammer, Lukas Prettner, Wiener Linien discovers new potential for rails in Urban Transportation Systems, tdhrail - The Asian Railway Magazine 2019 (2019).
5. E. Dartzalis, A. Joerg, Komplexe Herausforderungen, innovative Lösungskonzepte – Systemoptimierung bei der Sihltal Zürich Uetliberg Bahn SZU AG, ZEVrail 2014 (2014) 31–37.