Mechanical Carryover – A PowerPlant Chemistry® Survey

In cycles with drum boilers, contaminants may enter into and deteriorate the quality of the generated steam by three paths:

– mechanical carryover,

– chemical carryover, and

– attemperation.

The mechanical carryover is the focus of our survey, since it is the most decisive parameter influencing the quality of the generated steam. The chemical carryover significantly contributes to the transport of contaminants only at the highest drum pressures (about > 17 MPa or > 2 500 psia) [1]; the influence of attemperation can be neglected if its quality fulfils the commonly-known requirements on salt-free feedwater (cation conductivity ≤ 0.2 µS · cm–1, sodium content ≤ 3 µg · kg–1).

An important contribution of the Electric Power Research Institute (EPRI) was its introduction of a quantitative evaluation of mechanical carryover in its Interim Consensus Guidelines on Fossil Cycle Chemistry [2]. The source of the diagram reproduced here (*Figure 1*) is specified in these EPRI Guidelines as *a review with boiler manufacturers confirmed through private conversations*. This diagram, which originally covered the pressure region from 900–3 000 psig (about 6.2 MPa to 20.7 MPa), was used in a slightly different form – pressure region from 600–2850 psig (about 4.1 MPa to 19.7 MPa) – in subsequent EPRI cycle chemistry guidelines [1,3,4]. In [1], the diagram has a note that *the curve includes a safety factor of 2*. It is interesting to mention that the well-known VGB Guideline for Boiler Feedwater, Boiler Water, and Steam [5] does not adequately deal with mechanical carryover when discussing or defining the boiler water guide values [6].

Most operators in utilities and in steam-generating systems outside of utilities (industry and independent power producers) unfortunately do not know the actual percentage of the mechanical carryover in their units. This very often results in too high boiler water contaminant or boiler water treatment chemical levels and in this way in the contamination of generated steam.

Steam separation from water generally improves with an increase in the difference between water and steam density, while it deteriorates with a decrease in this difference. The original EPRI data come from 1986. They are supported by Bellows, who has found that the square root of the steam to water density ratio agrees with the EPRI mechanical carryover estimate within the probable error of the estimate (*Figure 2*) [7].

The PowerPlant Chemistry® journal would like to find out if the currently available data actually represent the situation in the field. For this reason, we ask our readers from utilities, industrial steam and power generating units, and boiler manufacturers to participate in a survey on mechanical carryover. Please supply us with the following data:

– Boiler pressure (design)

– Boiler pressure when determining the mechanical carryover

– Boiler steaming capacity (design)

– Steam output when determining the mechanical carryover

– Mechanical carryover (warranty)

– Mechanical carryover (actual)

– Operator (utility or industry)

We promise that your data will be dealt with anonymously and that they will not be passed on to any third parties. They will only be used to plot a point in Figure 1. The more information we receive, the more points will be indicated on the diagram, and the more up-to-date information on actual mechanical carryover will appear in one of the next journal issues.

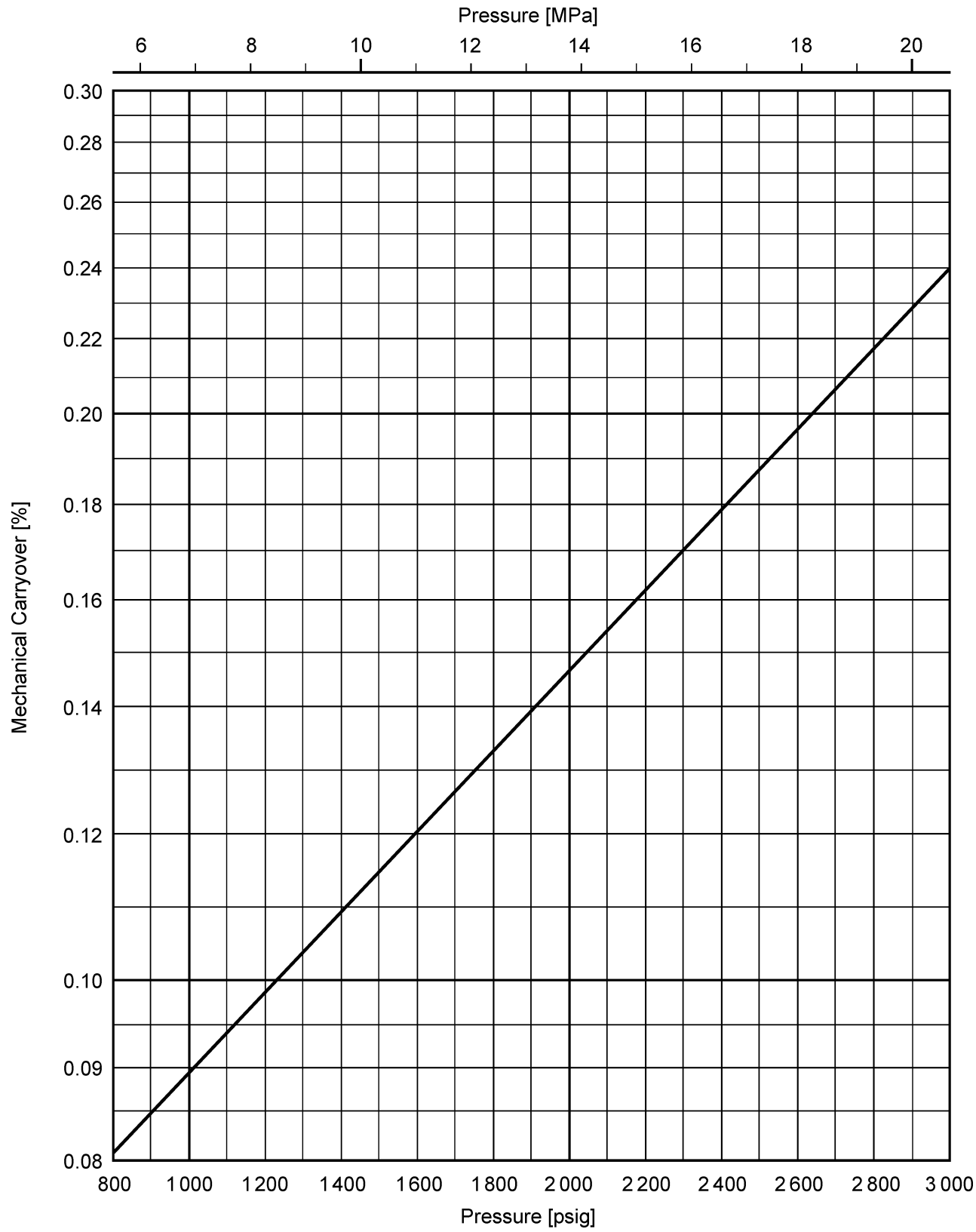
You may supply us with your information in any of the following ways:

– Fax to +49 6205 37883

– E-mail to editor@ppchem.net

– Letter to
PowerPlant Chemistry GmbH
P.O. Box 1269
68806 Neulussheim
Germany

Your participation in our survey is much appreciated. We thank you for your cooperation and quick response.



Source: Unpublished. Reviewed with boiler manufacturers and confirmed through private conversations.

Figure 1: Representative drum boiler mechanical carryover [2].

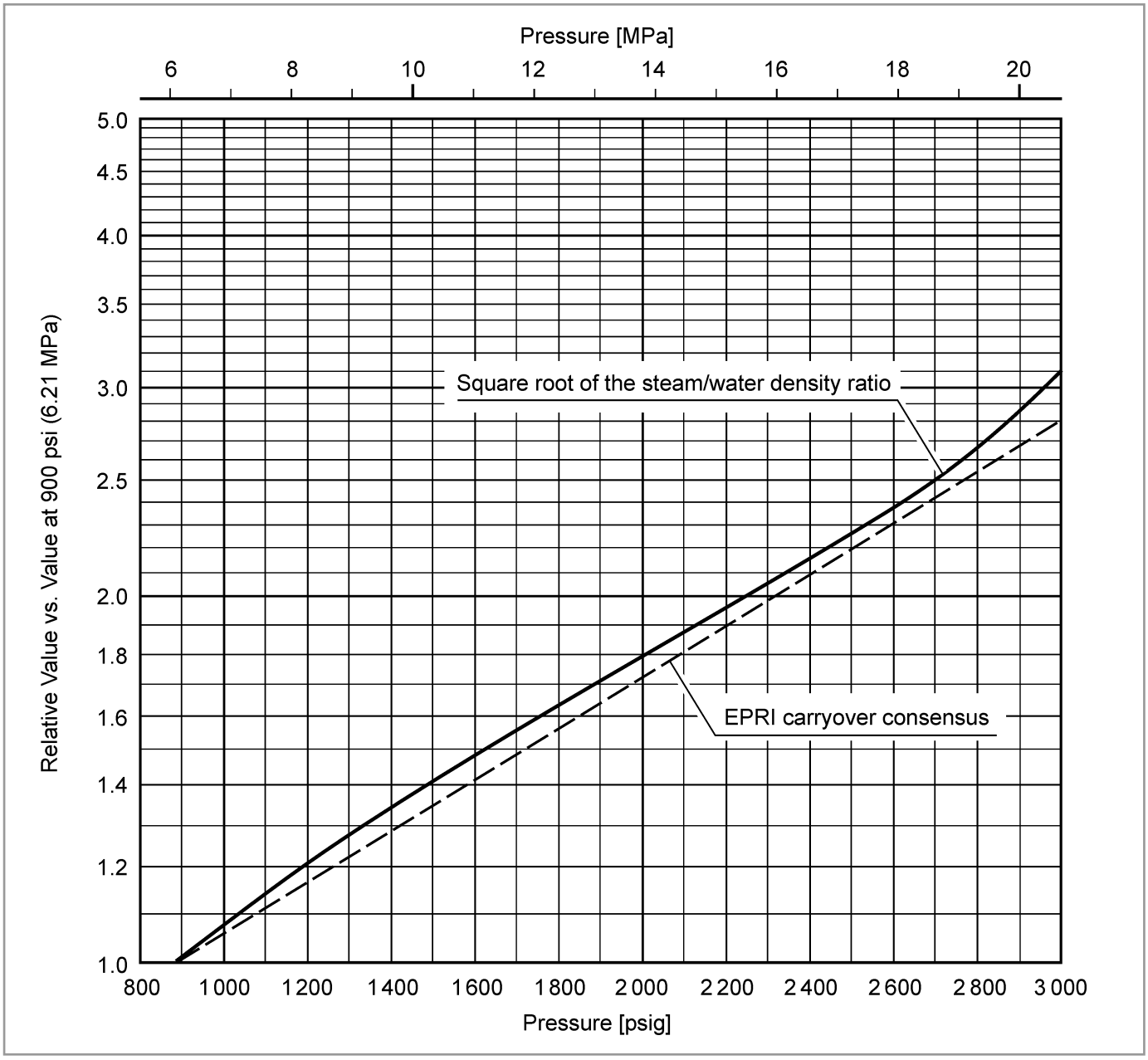


Figure 2: Boiler carryover and square root of steam to water density ratio as a function of pressure [7].

REFERENCES

[1] *Cycle Chemistry Guidelines for Fossil Plants: All-Volatile Treatment, Revision 1*, **2002**. Electric Power Research Institute, Palo Alto, CA, U.S.A., 1004187.

[2] *Interim Consensus Guidelines on Fossil Cycle Chemistry*, **1986**. Electric Power Research Institute, Palo Alto, CA, U.S.A., EPRI CS-4629.

[3] *Cycle Chemistry Guidelines for Fossil Plants: Phosphate Treatment for Drum Boilers*, **1994**. Electric Power Research Institute, Palo Alto, CA, U.S.A., EPRI TR-103665.

[4] *Cycle Chemistry Guidelines for Fossil Plants: All-Volatile Treatment*, **1996**. Electric Power Research Institute, Palo Alto, CA, U.S.A., EPRI TR-105041.

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[6] Bursik, A., *PowerPlant Chemistry* **2003**, 5(12), 740.

[7] Bellows, J. C., *Thermodynamic and Chemical Effects of Part Load Operation of Turbines*, **1997**. Library at Westinghouse Electric Corporation, Orlando, FL, U.S.A., WORL Report TP-97104.