1: Physical properties

Properties	Values
Atomic number	52
Atomic weight	127.6
Melting point	449.5 deg C
Boiling point	989.8 deg C
Density	6.24 gm/cm3

2. Use of Tellurium for inclusion modification

The use of Te for improving the machinability of sulphur containing steel has been in practice for several years. The basic effect of Te is to globularize the inclusions leading to better deformation characteristics during hot working of steel. The ratio [WTe]/[WS] has been found to be important. A [WTe]/[WS] ratio larger than 1 has been found to improve the deformability index of inclusions due to formation of a film of liquid around it, rich in Te

[1]. It has been reported that addition of 0.05% Te to leaded steels improves the machinability over the leaded once only

[2] Corus Steel [3] have optimized sulphur content which balances the conflicting benefit of low sulphur for fatigue properties and high sulphur for improved machinability. Thus it may be inferred that Low sulphur level is essential for attaining improved fatigue properties. They have used SAE 1548 modified for crankshaft. However chemistry has not been given.

One patent on rail steel

[4] consists of C 0.5-0.75%, 0.1-0.5% Si,0.9-1.5% Mn , and Te content of less than 0.004% & a sulphur content such that Te/S ratio is 0.1-0.6

It has been reported

[5] that when Tellurium is present in free machining steel , all the tellurium is in inclusion form, principally as lead telluride (PbTe) when lead is also present. Some of the tellurium may be present as manganese telluride. In conventional free machining , lead is normally present in the range of 0.25-0.35% and Tellurium is normally present in the range 0.04-0.06%.In the absence of lead, Tellurium is present as bismuth telluride (if bismuth is added) or as manganese telluride (MnTe) which may be in the form of eutectic with manganese sulphide (MnS). Sulphur content in such steel is 0.25-0.35%.

Micro-alloyed steel in one of the patents [6] for improved fatigue resistance employs the following preferred compositions:

02-0.5% C, 1-1.5% Mn , 0.05-0.15% V and S 0.001%-0.06%.

They have compared the endurance limits for SAE 1548 and TMS 80 micro-alloyed steels for crankshaft application. It may be noted that increasing S level has a detrimental effect on fatigue strength.

Steel grade	Endurance Limit (Mpa)
SAE 1548	724-772
TMS80 Low S (0.007%)	910
TMS 80 Med S (0.02%)	841
TMS80 High S (0.039%)	793

ISO 9001:2000

3. Addition Practice:

Stick tellurium is generally added to the pouring stream during ingot teeming, while ferro-tellurium is used for ladle additions. The latter practice gives better uniformity, but recovery is generally lower than with ingot mould inoculation. However manganese tellurium will give high recoveries even as ladle additions. Adding tellurium through a funnel in a covered continuous caster tundish is claimed to improve both distribution and recovery. Mn/Te ratio of the steel is recommended [7] to be more than 20 for improved hot working
Te-Mn cored wire is also used containing 70% Te and 30% Mn with wire dia of 9 and 13mm.

4. Te-Mn addition at Kalyani Steel:

Sulphur content at Kalyani steel is low (0.005-0.01%) Also the oxygen content is low (,10ppm). Addition of Te to such steel will globularize the sulphide inclusions and expected to improve fatigue properties though direct effect could not be obtained. Further literature search may give some insight in to this.
0.1 Kg /t of Te-Mn is expected to result in steel Te content of 0.0042% expecting recovery of Te ~60%.

5. References:

[1] Secondary steel making: principals and application, Prof A Ghosh, Page 269
[2] Effect of alloying elements in metals, Internet article.
[3] Corus brochure on Crankshafts
[4] Patent on rail steel, Patent No. 5711914(US)
[5] Semi-finished steel article, US Patent, Downloaded from internet
[6] Patent 5906691 on "Induction hardened micro alloy steel having enhanced fatigue strength properties.
[7] Ferroalloys and alloying additives On Line hand book.