ASM INTERNATIONAL Pune Chapter

Chapter News Letter

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Editor
Hemant Zaveri

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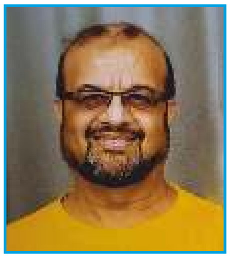
EDITORIAL . . . ✍



LAST IS FIRST

Dear Friends,

It gives me immense pleasure to present this edition of Chapter`s News Letter, put in place by chairman of the news letter committee, Shri Louis F. Vaz.

This is the last newsletter for the outgoing committee and the first for the new incoming committee. (hence the title of this column)

The present committee was captained and steered by Shri Bhimsen Galgali for nearly 08 years. During his tenure as the chairman, he took the chapter to great heights with some amazing conferences, workshops, technical presentations, etc. and brought unprecedented recognition to the chapter in the technical fraternity.

BRG, as Shri B. R. Galagali is known and addressed as, a hardcore metallurgist and an ardent ASMER has set very high benchmarks for the incoming committee. If I were to be wearing a hat, would have tipped the same as my acknowledgement of his great efforts.

The incoming committee will be headed by Shri Udayan Pathak, who incidentally, like BRG is also a hardcore metallurgists, an ardent ASMER and also from the Tata Motors` stable, and having many international patents and international papers published to his credit. He has also been bestowed with the title FASM (fellow of ASM), a very rare honour.

Udayan brings with him new thinking and newer ideas, and am confident that with support of all ASMERS, he too will take the chapter to greater heights and bring more laurels and greater recognition.

A very warm welcome to udayan and his team.

Leaving the readers with some thought provoking, what else but, thoughts:

- This life is too short for learning from your experiences, try to learn from others.
- Better to walk with friends in the dark than walk alone in light.

Regards,
Hemant k. Zaveri, Editor

VISION FOR ASM

Continues from Feb. 2019 Issue

The World is Changing: ASM International is not the same society it once was; it is even better. This has not come without challenges, and further challenges are ahead. Membership, chapter activities, and corporate involvement are critical to ASM's future success. Dave believes this success will come from being relevant and delivering value to members, companies, and the society.

ASM International Strategic Plan: Dave is passionately committed to implementing ASM's strategic and operational plans, which are focused on the core values and deliverables that will make ASM relevant today, tomorrow, and well into the future. Teamwork can accomplish amazing things. Dave is working with the Board of Trustees on board-led taskforces that represent the heart of ASM's values and goals. These taskforce efforts are defining changes that the society is undertaking to grow and improve, and they include a focus on education; committee structure; attracting and maintaining new members; the computational and digital materials environment; diversity and inclusion; and international activities. Each of these areas aligns with ASM's annual operating plan.

Dave is also working with the board to guide ASM toward a much enhanced committee structure, where technical committees can be spontaneously created by grassroots communities of practice. He believes that enhancing ASM's technical committees will enable great volunteerism. It has been pointed out that without a technical "home room," many members do not know how to engage and become involved in ASM activities. ASM is working on a process to allow groups to seamlessly stand-up committees on focused topics and specific purposes, such as developing Handbooks, technical books, and journal content, and supporting conference programming by proposing symposia topics. Restructuring the technical committees will help make ASM more relevant, thereby attracting new members and sparking interest in existing members to become more active in the society. ■

ADDITIVE MANUFACTURING CONFERENCE ON 27TH & 28TH FEBRUARY 2019

ASM INTERNATIONAL, Pune Chapter, hosted a two day International Conference and Exhibition on Additive Manufacturing at Hotel Orchid, Balewadi, Pune, India.

One hundred and twenty delegates attended the conference.

The conference began with the traditional lamp lighting ceremony, at the hands of the Chief Guest, Mr. Alok Kumar Singh, Plant Head, Tata Motors Limited, and other dignitaries and authors.

Mr. Alok Kumar Singh in his speech gave a brief account of the challenges faced with the automotive industries, and how newer technologies, such as Additive manufacturing, coupled with shorter lead time, would be a game changer.

Dignitaries after lighting the traditional lamp

Mr. Alok Kumar Singh, delivering his speech

Dr. Ing Jan Dzugan, R&D Director COMTES FHT a.s. Dobrany, Czech Repbulic, delivered the keynote speech on "Characterization of Additively Manufactured alloys Challenges and Opportunities."

A total of sixteen papers from eminent scholars and technocrats of international repute, were presented at the conference.

The topics covered were:

1. Characterization of additively manufactured alloys – challenges and opportunities by Dr.Jan Dzugan from Comptes FHT Inc., Czech Republic.
2. 3D and Industrial Components – Dr. Sundar Atre - University of Louisville, USA.
3. The Digital foundry : Direct Digital Investment Casting using LAMP technology – Dr. Suman Das Founder and CEO DDM Systems.
4. Additive Manufacturing for Gas Turbine Hot Gas Path Components – Dr. Dheepa Srinivasan, CTO-INTECH, DMLS, India.
5. Application of 3D Printing in Metal Casting Industry – Dr. Mukesh Agarwal, 3D Product Development.
6. Laser Metal A.M-Process and Built Properties – Dr. Gururaj Telesang, International Advanced Research Centre for Powder Metallurgy and New Materials.
7. Adoption of AM and Application Notes – Mr. Nikhil Chowdary, Wipro 3D.
8. The Role of Additive Manufacturing in the Future of Design – Mr. Gauresh Khanolkar, Chizel.
9. Soundness Dimensional Measurement of 3D parts – Mr. Hemant Kumar, Carl Zeiss India


A view of the audience

Dr. T.S. Sudarshan at the Valedictory

Delegates ,Authors exhibitors and EC members

Pvt. Ltd.

10. Additive Manufacturing: Application in High Pressure Fuel Industry – Ms. Ruta Barve, Cummins India Ltd.
11. Evaluating the Effect of Built Orientation on Mechanical Properties and Total Cost of FDM Parts – Dr. Vijay Kumar Jatti, DY Patil College of Engineering, Pune
12. Validated Particles Scale Model of SLM Additive Manufacturing Process – Dr. Arvind Kumar, Indian Institute of Technology, Kanpur.
13. Print to Perform : Simulation for Additive Manufacturing – Mr. Vishal Suvane, Simulia Dassault Systems.
14. 3D and Surface Engineering – Dr. T. S. Sudarshan, Mat Modification.
15. Characterization of Powders for 3D Printing – Dr. Sundar Atre, University of Louisville, USA.
16. Digital Disruption in Industries, Additive Manufacturing, micro CT and advances in software and analytics, impact on us and how the future is happening – Mr. Samaresh Chagdar, BHGE.

The last session of the conference was Panel discussion & open hours. The panelists were Dr. Sudarshan, Dr. Sunder Atre, Mr Samresh Chagdar and Mr. Gauresh Khanolkar. The panel discussion was moderated by Mr. B R Galgali. Panelists were asked to express their opinion on following three main apprehensions Indian industries have about Additive Manufacturing.

- The availability of different powders for 3D printing and it's cost.
- Validating the process with various mechanical testing.
- How to validate the process before mass producing.

The panel members, then gave their views on each of the above topics.

The session ended with Valedictory function chaired by Dr. T. S.Sudarshan.

The concurrent exhibition on Additive Manufacturing was well attended by delegates and visitors. Renowned Engineering Companies such as Bharat Forge, Zeiss, and Wipro and others had their stalls. Two local Engineering Colleges also displayed 3D Printing machines manufactured by the students. Visitors were seen crowding the Engineering College stalls, with lot of questions to the young college students.

■

Mr. Alok Kumar Singh at the exhibition

A college student explaining his exhibit

STUDENT OUTREACH

ASM International Pune Chapter takes great interest and pride in reaching out to students. As part of Student Outreach, ASM Pune Chapter conducted two programs for students in the month of March 2019.

On 28th March 2019, Mr. Avinash Arankalle (Faculty and Advisor in Engineering Materials, Pune) gave a talk on Materials and Metallurgical engineering in Automotive Industry at Sinhgad College of Engineering, Pune. Mr. Arankalle has over 41 years of experience in the field of Metallurgical engineering, he is specializing in selection of engineering materials. He has over 75 technical papers presented at the national and international forums.The talk was well received by the students. 40 students attended this talk.

The second talk was conducted at Government Polytechnic, Pune on 29th March 2019.The subject was Metallography and Microstructure of Cast Iron with measurements of Metallurgical aspects in Cast Iron. Mr. D.G Chivate of ASM, Pune Chapter and Mr. Nimbalkar of Metnation Technology Solutions conducted the talk. Actual microstructures of cast iron samples were displayed on the screen and explained to the students. The students got a rare opportunity to see different samples of cast irons used in industry, and the interpretations of different phases seen in the microstructures. 46 students attended this talk.

ASM International Pune Chapter and ALD Dynatech Furnaces Pvt Ltd., ,held a workshop and technical lecture on Vacuum Heat Treatment By Ulrich Dittrich, International Sales Engineer, ALD Vacuum Technologies, GmbH at Royal Connaught Boat Club, on 5th May 2019.

In the workshop Mr.Ulrich, explained the principal of vacuum furnaces ,He explained how the vane pump works and how the vacuum is generated, .he then went on to explain the different stages of development in vacuum furnaces, he also explained with photographs the latest development of vacuum furnaces at ALD.

In the technical talk Mr. Ulrich gave an overview on ALD, he then explained the Basic of vacuum, Basic of LPC, Basic of high pressure gas quenching (HPGQ), Furnace technology Modultherm, Furnace technology MonoTherm and Syncrotherm, Furnace technology for control for distortion, and Furnaces with water cooled vessel – applications under vacuum. The talk was very well received as per the feedback form filled by the participants.

Mr. D.G.Chivate giving his presentation

Students at the lecture

The audience at the technical lecture

Mr. Ulrich at the workshop

STUDENTS' MATERIAL CAMP

A three day Students' Materials Camp was held at the College of Engineering, Pune, from the 20th to 22nd May 2019.

This Camp was arranged by ASM International, Pune Chapter, In association with the Metallurgy Department, College Of Engineering, Pune, & ARAI, Pune.

The camp was aimed at generating interest in young minds in one of the leading and expanding field of material science , through an exciting way.

The Students' Materials Camp was a three days fun-cum-learning material science camp.

Practical experiments were shown on various subjects, such as Corrosion, Non destructive testing, Heat Treatment, Hardness and Tensile testing, Welding and Microstructures of metals and alloys.

Students were also given a Demonstration on 3D Printing and Robotics

A whole day Industry visit to Tata Motors ltd., and Automotive Research Association of India, was arranged. The students were fascinated seeing the technology in these two organizations.

Dr. S.P..Butee of College of Eng.,. Pune, interacting with the students

students watching a demonstration

Mr. Zaveri of ASM, Pune explaining the construction of thermocouple

The students at Tata Motors, Pune

Know Our Members

Mr. Rajendra M Patil is currently working as Asst. General Manager & Heading Heat Treatment + Metallurgy lab at M/s Z F Steering Gear India Ltd. VaduBudruk, Pune.ZF Steering Gear (India) Ltd..As a Head Metallurgist, since last 7years, he is responsible for Heat Treatment & metallurgy lab departments of M/s Z F Steering Gear India Ltd,,His Qualification is DMETE.

He has over 23 years of experience in establishing various Conventional as well as Auto SQF, CGCF,Rotary press quench f/c,Vacuum Heat Treatment, Processes on Forged as well as machined parts. He is well conversant with Steel Manufacturing, Cold & Hot Forging Processes,Induction, conduction& Laser Hardening etc. Apart from this, he is well versed with various types of Surface Treatments such as AL-ZN Coating, zinc phosphating etc.

Visit's at Germany, South Africa helped him for successful commissioning of Auto lines of SQF, CGCF Furnace-"CHT Process" at M/s Z F Steering Gear (I) Ltd. , as one of the major tasks.

RAJENDRA M. PATIL

Rajendra has also worked with companies like M/s Patheja Forging Ltd., M/s Orlicon FairfieldLtd. Kolhapur &Truetherm Heat treat Pvt Ltd, with whom he started his carrier.

Rajendra is having an exposure of IATF 16949, AS 9100, ISO14001,OHSAS18001, CQI9& NADCAP requirements.

In his overall career, he has got an exposure to handle forged / machined parts of Ferrous, Non-Ferrous, Stainless Steel & Tool Steel material & it's various Heat Treatment as well as Surface Treatment Processes. He has developed the components required for typical applications like Automotive, Aerospace, Defence, Industrial, Locomotive, Fuel Injection System, Hydraulic System, Turbo Charger etc.

He may be contacted on:

_rajendra.patil@zfindia.com / 9325302741

Effect of heat treatment on strength and ductility of 52CrMoV4 spring steel.

VJ Matjeke, G Mukwevho, AM Maleka, JW van der Merwe

Introduction

The manufacturing of heavy duty springs from steel requires an exact understanding of the heat treatment process and material behaviour. Although the presence of alloying elements can improve the mechanical properties, they also escalate the cost of the steel [1]. Therefore, the selection of the steel and manufacturing process must be robust in such a way that the spring will exhibit excellent strength and ductility with minimal alloying elements. Furthermore, it is important to select a quenching media that will harden the steel without forming quench cracks or distortion. This is a function of the selected heat treatment process, the quenching media and the alloying elements in order to provide acceptable mechanical properties. The heat treatment process alters the microstructure and strength of material, which will directly influence fatigue life [2].

Spring manufacturing requires materials with good formidability as well as strength in order to improve performance [3]. The majority of automotive springs are made from medium carbon high strength steels [4]. To increase the strength of the steel is simple, however, it is difficult to get a combination of high strength and ductility. Generally, an increase in strength results in a loss of ductility [5]. This study will focus on the heat treatment process, microstructure and mechanical properties of spring steel. The manufacturing process of the springs entails high temperature coiling, hardening and tempering [6].

This study will investigate whether a heat treatment process can make a conventional 52CrMoV4steel compete with advanced high strength steel (AHSS). The strength and hardenability of the 52CrMoV4 steel is improved by additions of elements such as chromium, molybdenum and vanadium. Molybdenum provides solution strengthening in steel during heat treatment, while chromium and vanadium forms carbides that improve the hardness of the material during tempering [7]. Molybdenum also forms fine carbides precipitates that increases the strain hardening effect [8]. On the other hand vanadium has been used as a micro -alloying element for high strength low alloy steels since the 1950s [9]. It improves the strength and hardness by formation of vanadium carbides and grain refinement [10]. With the effort to increase the strength, precaution is required to avoid temper embrittlement [11]. The strength is a critical factor in determining the fatigue life of a material.

Experimentation and material

A 52CrMoV4 steel rods were cut into 25 X 320 mm sections. The samples were placed in the furnace when it stabilised at 860 °C, thereafter the samples were soaked and austenitised at 860 °C temperature for an hour. The samples were quenched in oil with the quenching properties as shown in Table 1. Three tempering temperatures were used: 410, 450 and 470 °C; and two tempering times for each temperature, namely: 2 and 3 hours. The continuous cooling curve (CCT) of the steel were simulated using JmatPro software by inserting the chemical composition of the spring steel. The chemical composition was determined with a Bruker optical emission spectrometer. The oil quenching ability was analysed with a portable quenchant test system (IVF smart quench). The transverse section of the rod was cut, ground and polished to a 1 μm surface finish for metallographic examination. The polished surface was etched with a 3% Nital reagent. The microstructure was characterised with the optical microscope and SEM, while the penetrant test (PT) was used to determine the presence of quench related flaws. Micro hardness profile measurements were conducted across the transverse section of the steel rod from one edge to the other edge at a 1 mm interval

Chemical Analysis

The chemical composition of the spring steel is presented in Table 1. The chemical analysis confirmed that the steel is a micro-alloyed 52CrMoV4 steel containing 0.19 wt% Mo and 0.11 wt % V. The addition of Mo and V alloying element improves the hardenability of the steel.

Table 1. Chemical composition of the steel in weight percentage

Element	% C	% Si	% Mn	% P	% S	% Cr	% Ni	% Cu	% Mo	% V
Mass %	0.55	0.28	0.92	0.012	0.007	1.05	0.01	0.01	0.19	0.11

Microstructural Examination

The general microstructure of the as quenched spring steel was martensitic. There was no evidence of cracks or quenching related flaws. The XRD analysis of the as quenched steel revealed the structure to be a mixture of martensite (79%), iron carbide (19.8) and ferrite (2%).. The as tempered microstructures are presented in Figures 6 to 11.

The general microstructure was tempered microstructure. Figures 6 to 11 revealed the decomposed unstable martensite to tempered martensite. The SEM analysis images are shown in Figures 12 to 17. Figure 12

2showed rod shaped iron carbide (Fe3C) layered around ferrite that retained the high-density dislocation of martensite. Figures 13 and 14 showed ferrites with low density of dislocation and the mixture of rod-shaped and spherical iron carbides (Fe3C). Figures 15 to 17 presented a structure of tempered martensite which is predominately made up of spherical and rod-shaped carbides. There is a presence of needle like carbides as well. The observation on the samples tempered 2 hours was a microstructure with rod shaped carbides whilst the samples tested for 3 hours showed pronounced spherical carbides.

Figure 6. Microstructure tempered at 410°C for 2 hours

Figure 7. Microstructure tempered at 410°C for 3 hours

Figure 8. Microstructure tempered at 450°C for 2 hours

Figure 9. Microstructure tempered at 450°C for 3 hours

Figure 10. Microstructure tempered at 470°C for 2 hours

Figure 11. Microstructure tempered at 470°C for 3 hours

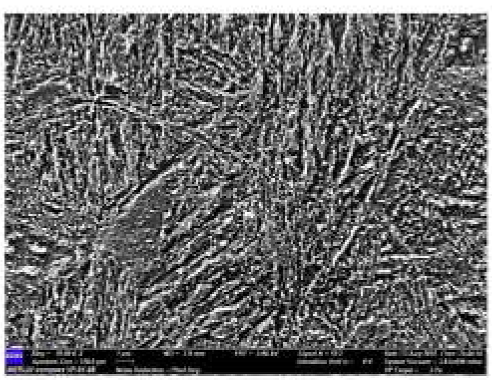


Figure 12. Microstructure tempered at 410°C for 2 hours

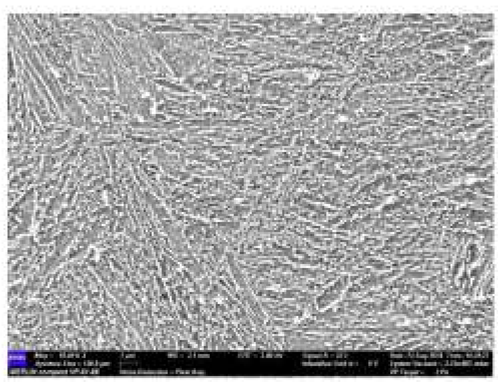


Figure 13. Microstructure tempered at 410°C for 3 hours

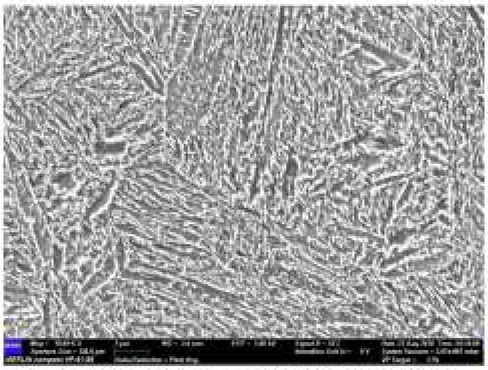


Figure 14. Microstructure tempered at 450°C for 2 hours

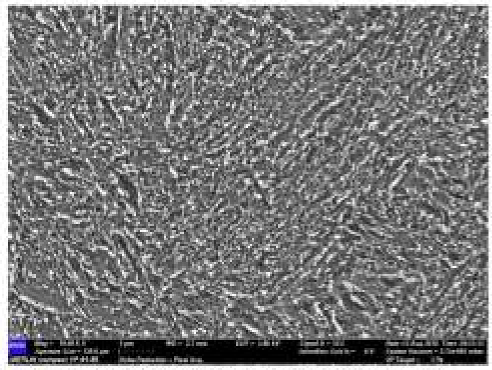


Figure 15. Microstructure tempered at 450°C for 3 hours

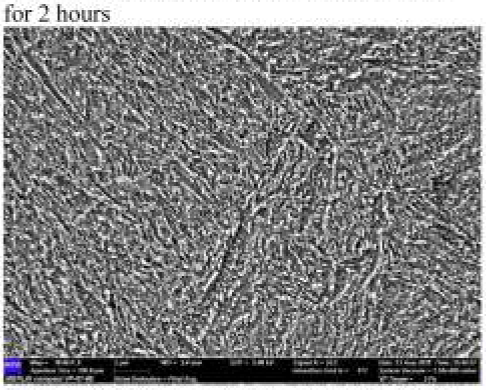


Figure 16. Microstructure tempered at 470°C for 2 hours

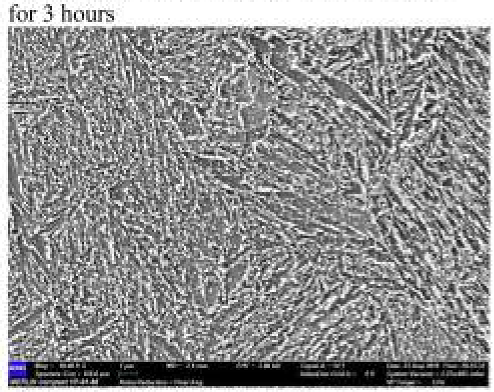


Figure 17. Microstructure tempered at 470°C for 3 hours

Mechanical properties

The as-quenched and tempered microhardness results are illustrated in Tables 3 and 4 The hardness generally decreased with the increase in tempering temperature, however the sample that were tempered for 3 hour showed evidence of secondary precipitation hardening when compared to the material tempered for 2 hours (see Figure 13). The secondary hardening was as a result of coalesce of Mo_3C and V_4C_3. On the other hand, the strength decreased, and ductility increased with the increase of tempering temperature. The tensile results are shown in Figure 19 and Table 5. The elastic region of the tensile test sample showed elastic behaviour or spring effect until yielding point.

Table 3. The as quenched hardness measurements

Average	Standard Deviation	Standard Error
804	15	3.03

Table 4. The tempered hardness profile average

Measurements	Average	Standard Deviation	Standard Error
410°C 2hrs	521	12.4	2.6
410°C 3hrs	524	17.3	3.6
450°C 2hrs	475	12.8	2.7
450°C 3hrs	491	15.5	3.2
470°C 2hrs	482	14.6	2.9
470°C 3hrs	486	12.7	2.6

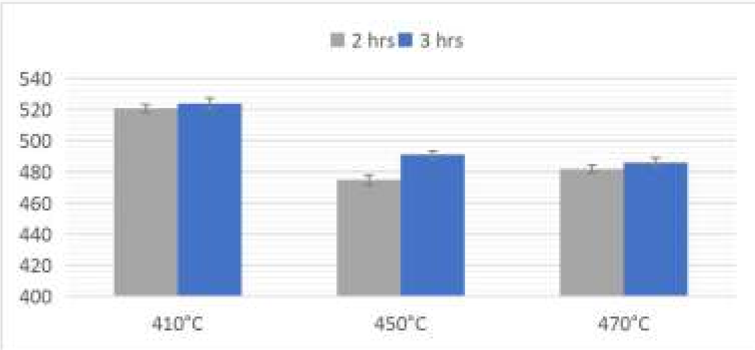


Figure 18. Hardness measurements for various tempering temperatures and times

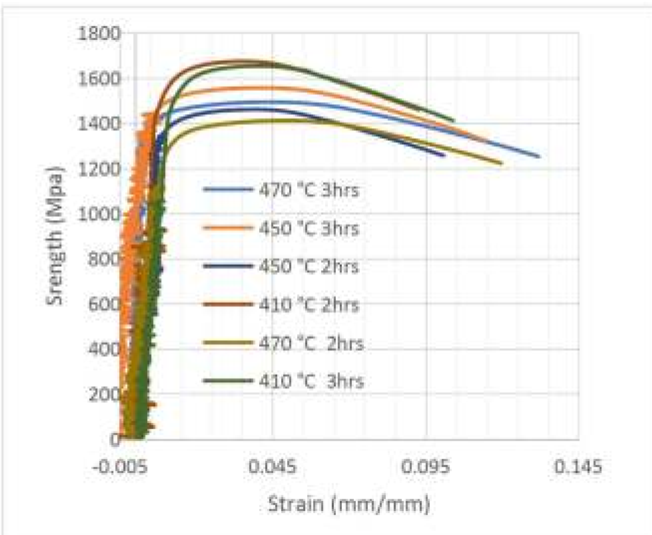


Figure 19. Tensile curves of quenched and tempered steel.

Table 5. Tensile strength and total strain of quenched and tempered steel.

Tempering Parameters	Ultimate Tensile Strength (MPa)	Yield Strength (MPa)	Strain (%)
410°C 2h	1674	1633	9
410°C 3h	1655	1608	10
450°C 2h	1462	1424	11
450°C 3h	1558	1516	12
470°C 2h	1412	1343	12
470°C 3h	1495	1420	13

Conclusions

The presence of molybdenum and vanadium influenced the mechanical properties by forming fine carbides precipitates that introduced secondary precipitation hardening. The optimum strength and ductility of the spring steel was improved by subjecting the material to various tempering 6temperatures and soaking time. The study also showed that tempering time is an important variable in influencing precipitation hardening. The amount of Mo-rich and C-rich fine precipitates (carbides) varied at different tempering temperatures and soaking times. However, the amount carbides increased with increase in temperature. Tempering of 52CrMoV4 material at 470°C for 3 hour has provided high strength and excellent ductility. The findings of this scientific study will assist spring manufacturers optimise the mechanical properties of the spring steel.

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