

## References

- [1] Chester T, Sims. and William C, Hagel. The Superalloy. John Wiley & Sons, Inc. Newyork. 1972.
- [2] B. Bergman. "Creep Deformation of hardened 80% Ni-20% Cr Alloys" Scandinavian Journal of Metallurgy. 4. 1975: 97-108.
- [3] J. Cadek. Creep in metallic materials. Czechoslovak Academy of Sciences, Academia Prague. 1988: 60-64.
- [4] J. Cadek, P.Y. Liu, Y.S. Yu, M. Pahutova, V. Sustek, and J. Zrník "A Study of Creep in a Nickel base 16Cr-10W-4Mo-TiAl Heat Resistant Alloy" Acta Techn. CSAV 37. 1992: 527-570.
- [5] G.E. Dieter. "Creep and Stress Rupture" in Mechanical Metallurgy. McGraw-Hill, Materials Science & Metallurgy. London. 1988.
- [6] R.W. Evans and B. Wilshire. An Introduction to Creep. The Institute of Materials. 1993.
- [7] J. Zrník and V. Vrchovinsky, "Heat treatments structure modification of wrought nickel base superalloy and its creep resistance" Journal de physique IV 3. 1993: 283-288.
- [8] W. Yangqing, M. Debashis, C. Weiye, K. Thomas, P.W. Rajeshwar, and W. Hans. "The Cyclic Creep Behaviour of Nickel base Superalloy IN 738 LC" Metalkd, 86. 1995: 365-370.

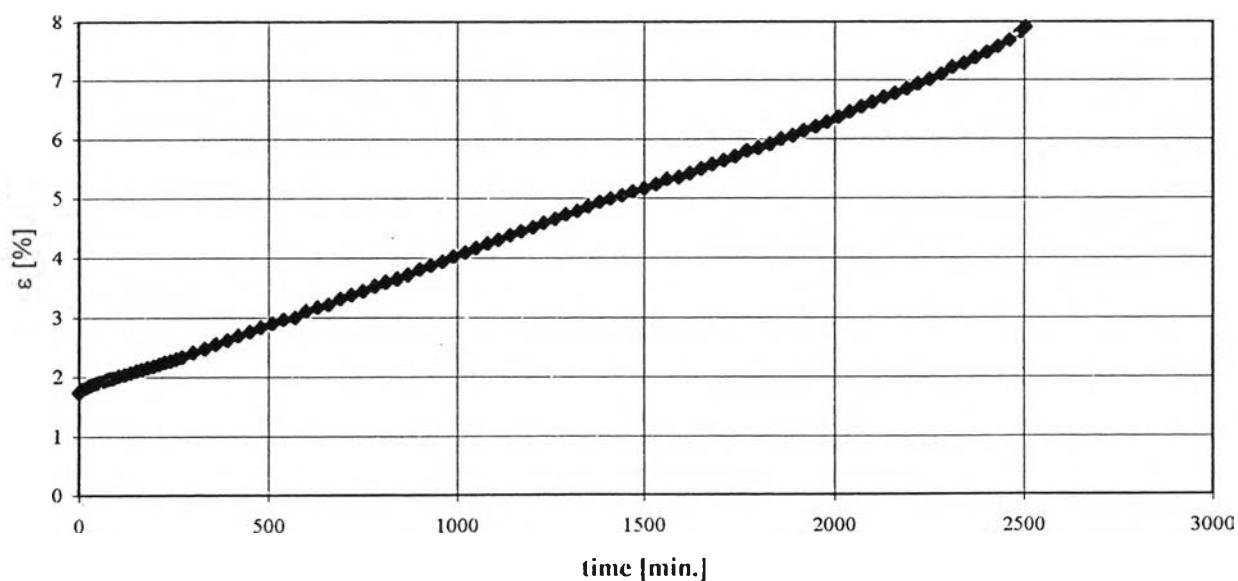
- [9] P. Rodriguez, and K. Bhann Sankara Rao. "Nucleation and Growth of cracks and Cavities under Creep-Fatigue Interaction" Progress in Materials Science 37. 1993: 403-480.
- [10] J.K. Tien, S.V. Nair, and V.C. Nardone. "Creep-Fatigue Interaction in Structural Alloys" in Superalloys, Supercomposites and Superceramics. Academic Press, Inc. 1989: 301-317.
- [11] X. Wang, D.N. Wang, and Q.P. Kong. "Creep and Fatigue Interaction in a Nickel based Alloy" Scripta Metallurgica et Materialia. 28. 1993: 401-404.
- [12] J. Zrník, Z.G. Wang, Y. Yu, J.A. Wang and M. Zitnansky, "Creep fatigue behaviour of directionally solidified nickel base superalloy". (To be published).
- [13] J. Zrník, P. Wangyao, V. Vrchovinsky, P. Hornak, and I. Mamuzic. "Deformation Behaviour of Wrought Nickel base Superalloy in Conditions of Thermomechanical Fatigue" Metalurgija. 36 /4. 1997: 225-228.
- [14] P. Wangyao, E. Nisaratanaporn, J. Zrník, V. Vrchovinsky, and P. Hornak "High Temperature Properties of wrought Nickel base Superalloy in Creep-fatigue Conditions" Metals, Materials and Minerals. 7 (1). 1997: 1-12.
- [15] V.J. Colangelo and F.A. Heiser. "Mechanical Testing" in Analysis of metallurgical failures, John Wiley & Sons, Inc. Newyork. 1989.
- [16] Robert E. Reed Hill and Reza Abbaschian "Thermally activated plastic deformation" in Physical metallurgy principles, PWS publishing company. Boston, MA. 1994.
- [17] R.W.K. Honeycombe. "Creep in pure metals and alloys" in The plastic deformation of metals, Edward Arnold, 1984.

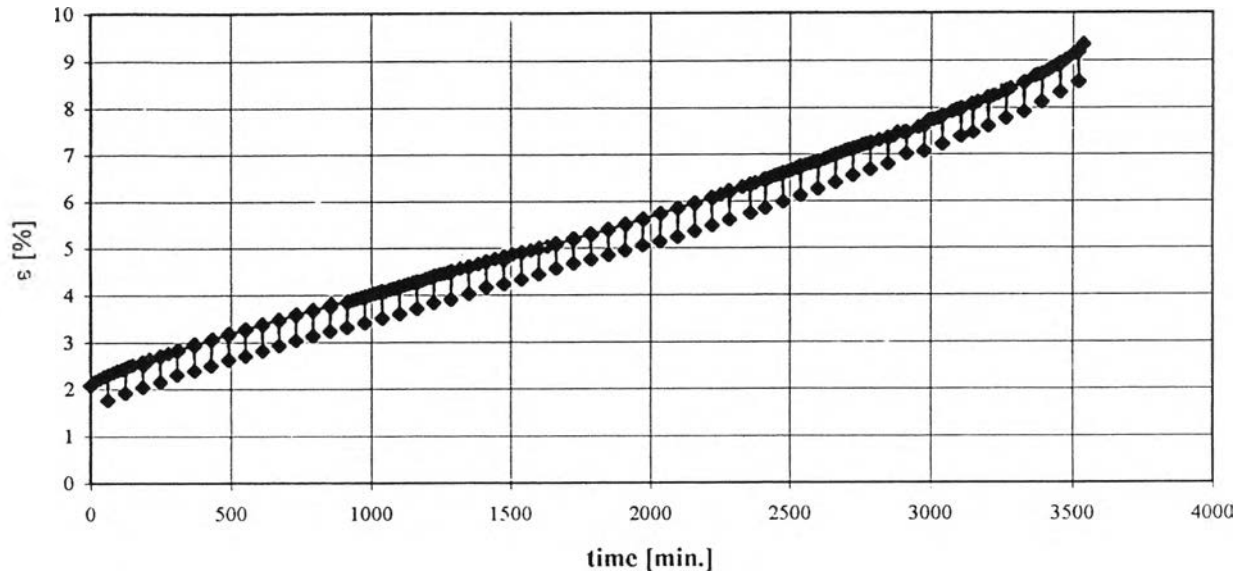
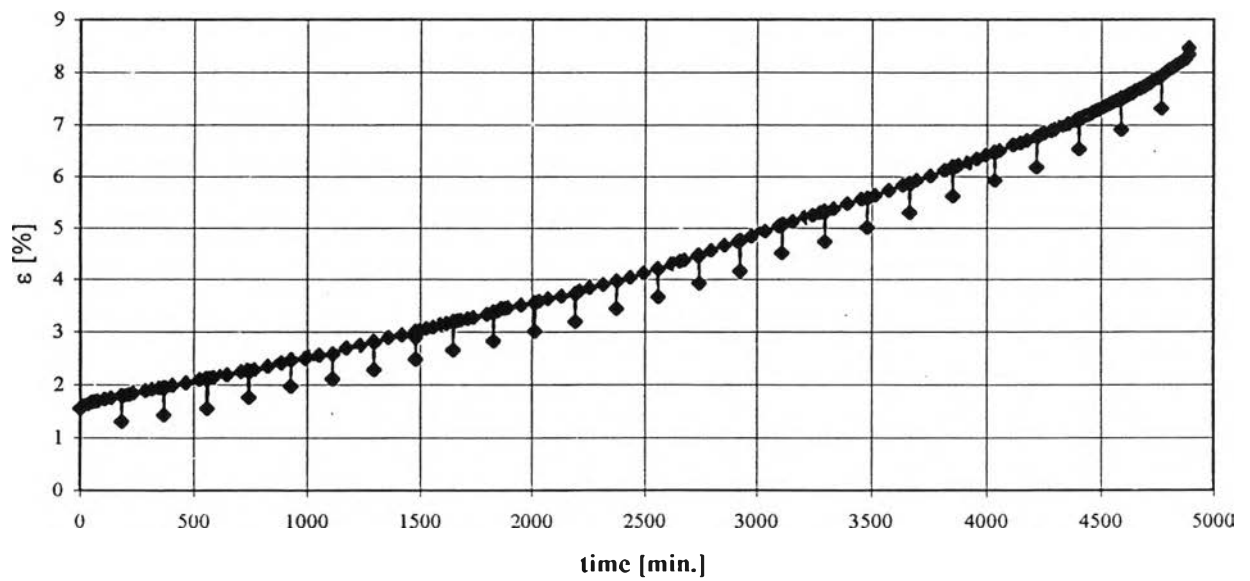
- [18] Thomas H, Courtney. "High temperature deformation of crystalline materials" in Mechanical behaviour of materials, McGraw-Hill, Materials Science & Metallurgy. London. 1990.
- [19] D.N. Wang, X. Wang and Q.P. Kong, "Cyclic creep behaviour of a nickel based superalloy under different types of fracture" Materials Science and Engineering, A142. 1991: 157-161.
- [20] Zhu Shijie, Yang Zhian and Wang Zhongguang, "Cyclic creep deformation and fatigue of a Cr-Mo rotor steel at elevated temperature", Chin. J. Met. Sci. Technol., Vol.8. 1992: 255-260.

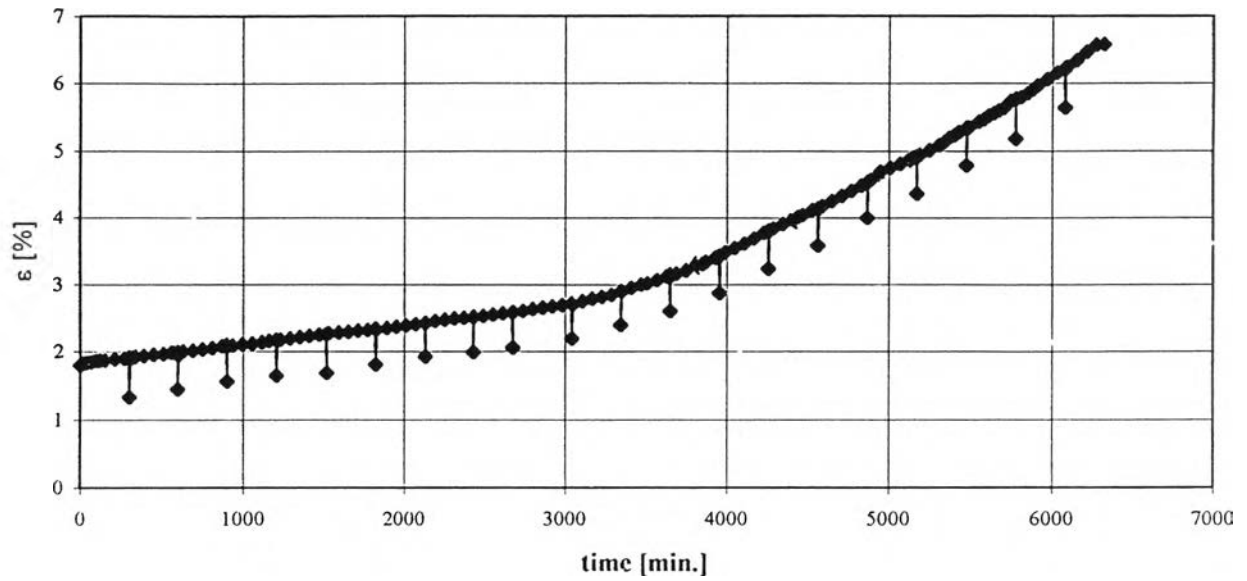
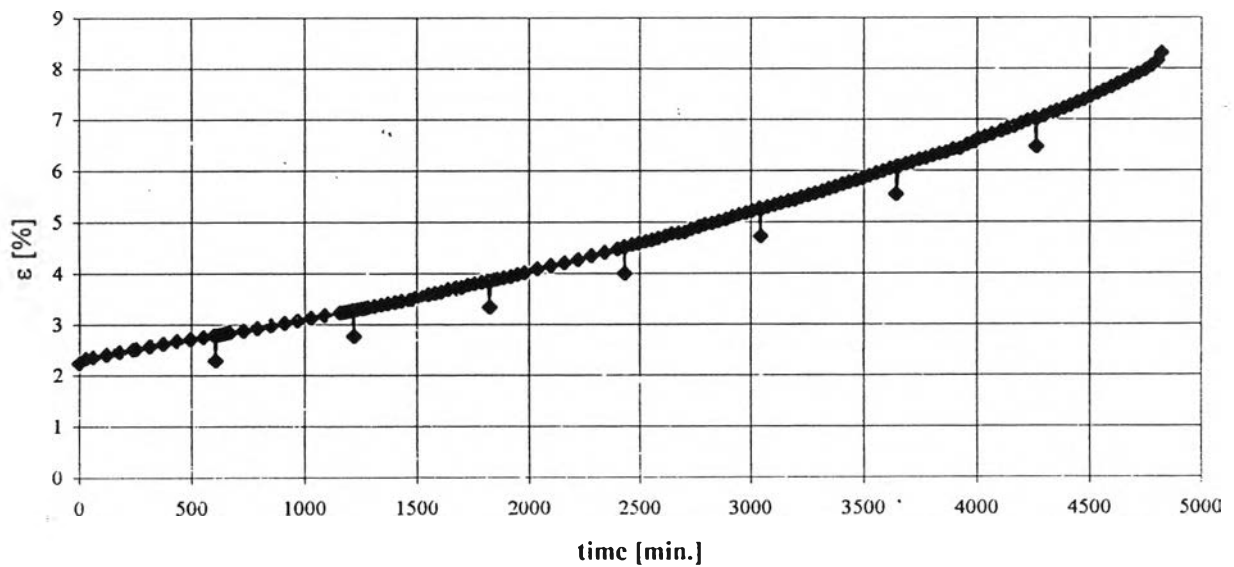
## Appendix

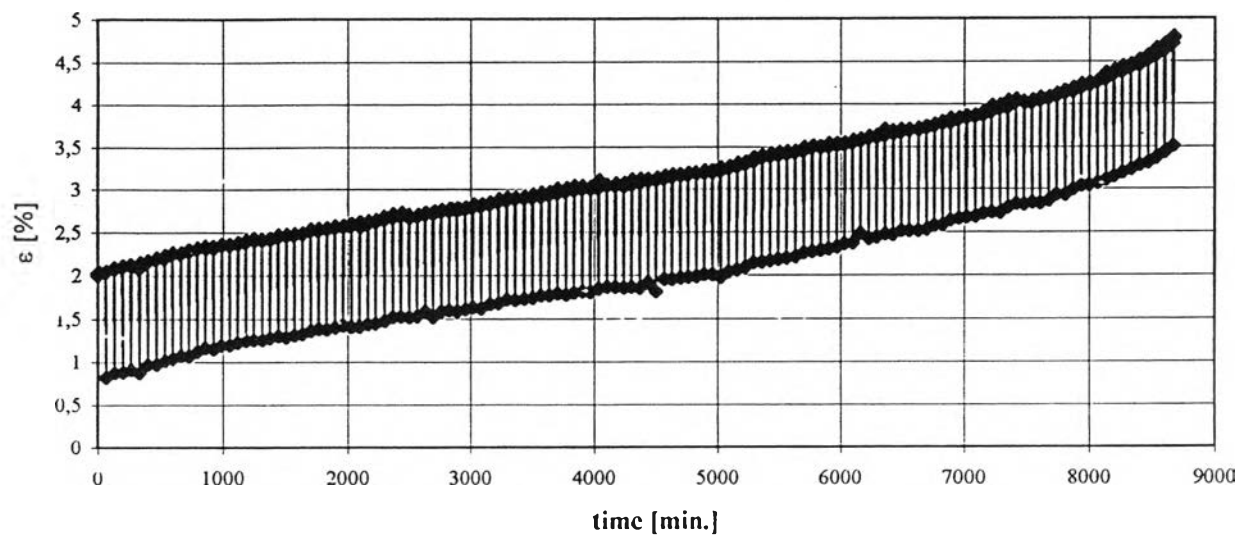
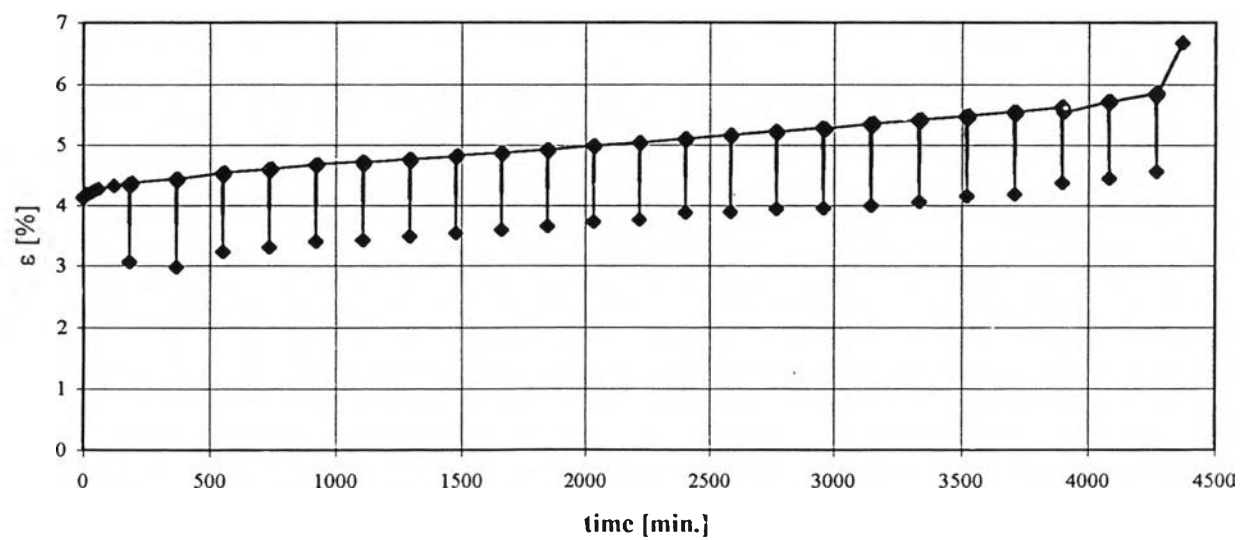
**Examples of Creep, Isothermal Cyclic Creep and Cyclic Creep with Thermomechanical Stress Component Curves with Exhibition of Strains when Unloading Time including the Expression of Initial Strain at the beginning Time of Testing as well as Comparing together**

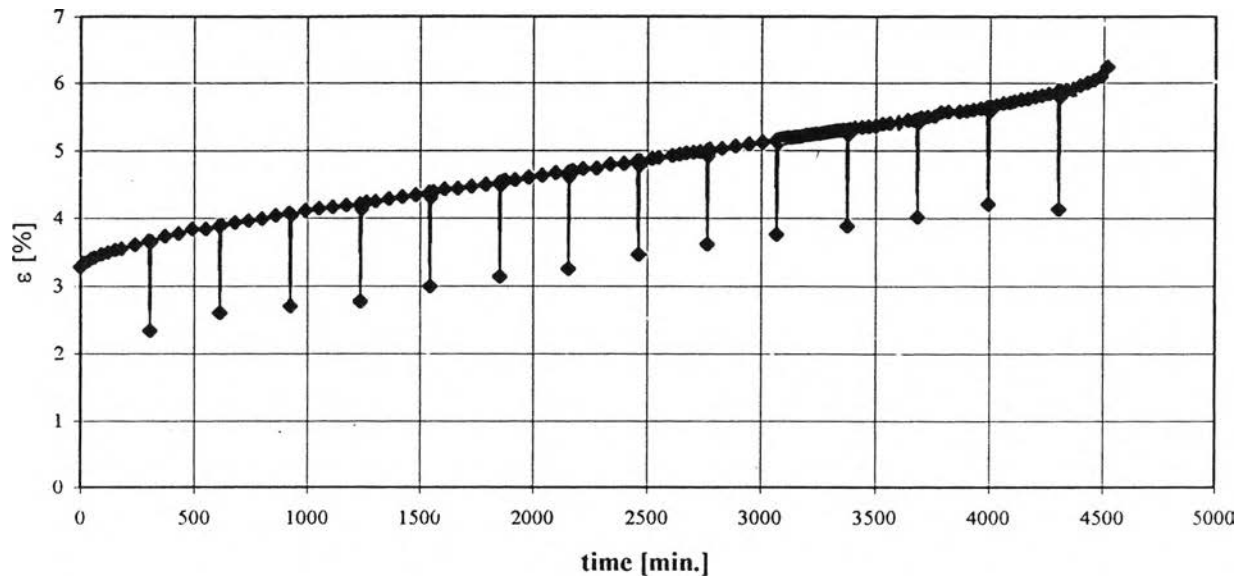
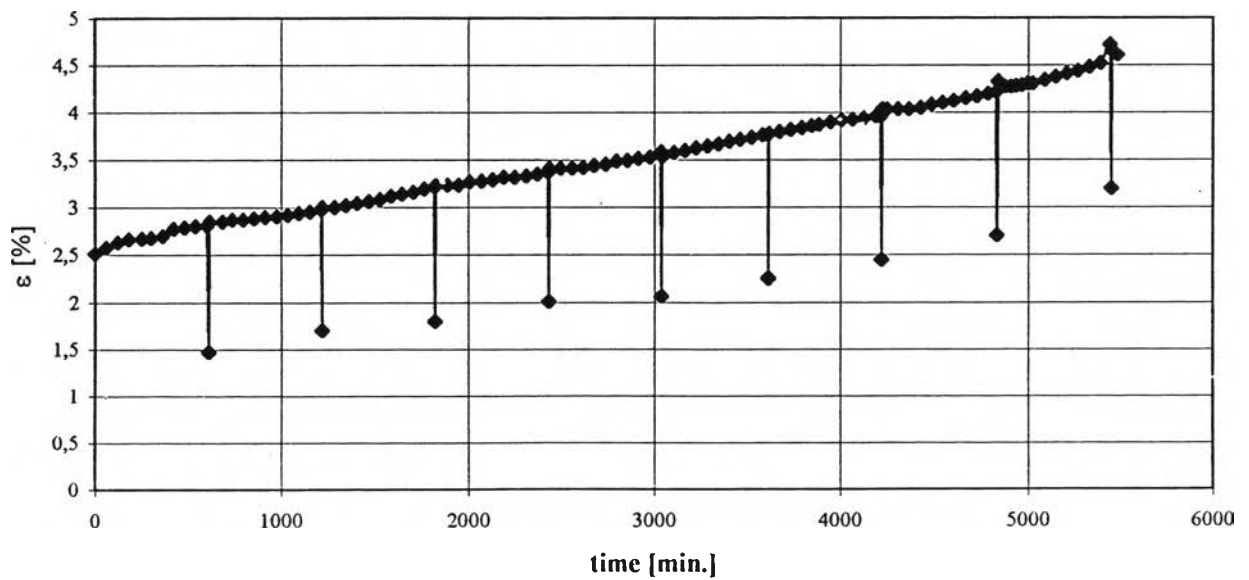
Creep - Stress 740 MPa



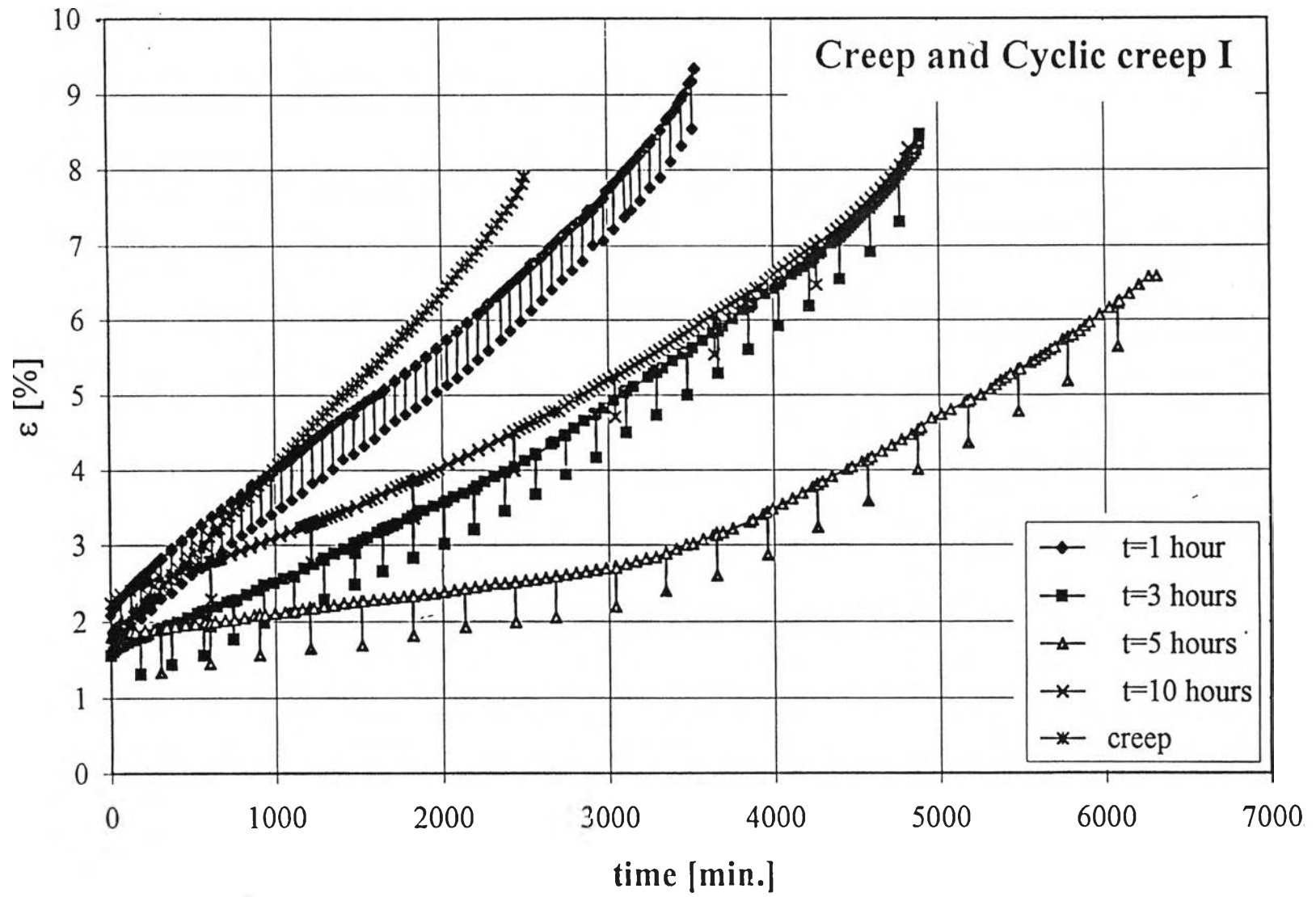
Cyclic creep I -  $\Delta t=1$  hourCyclic creep I -  $\Delta t=3$  hours

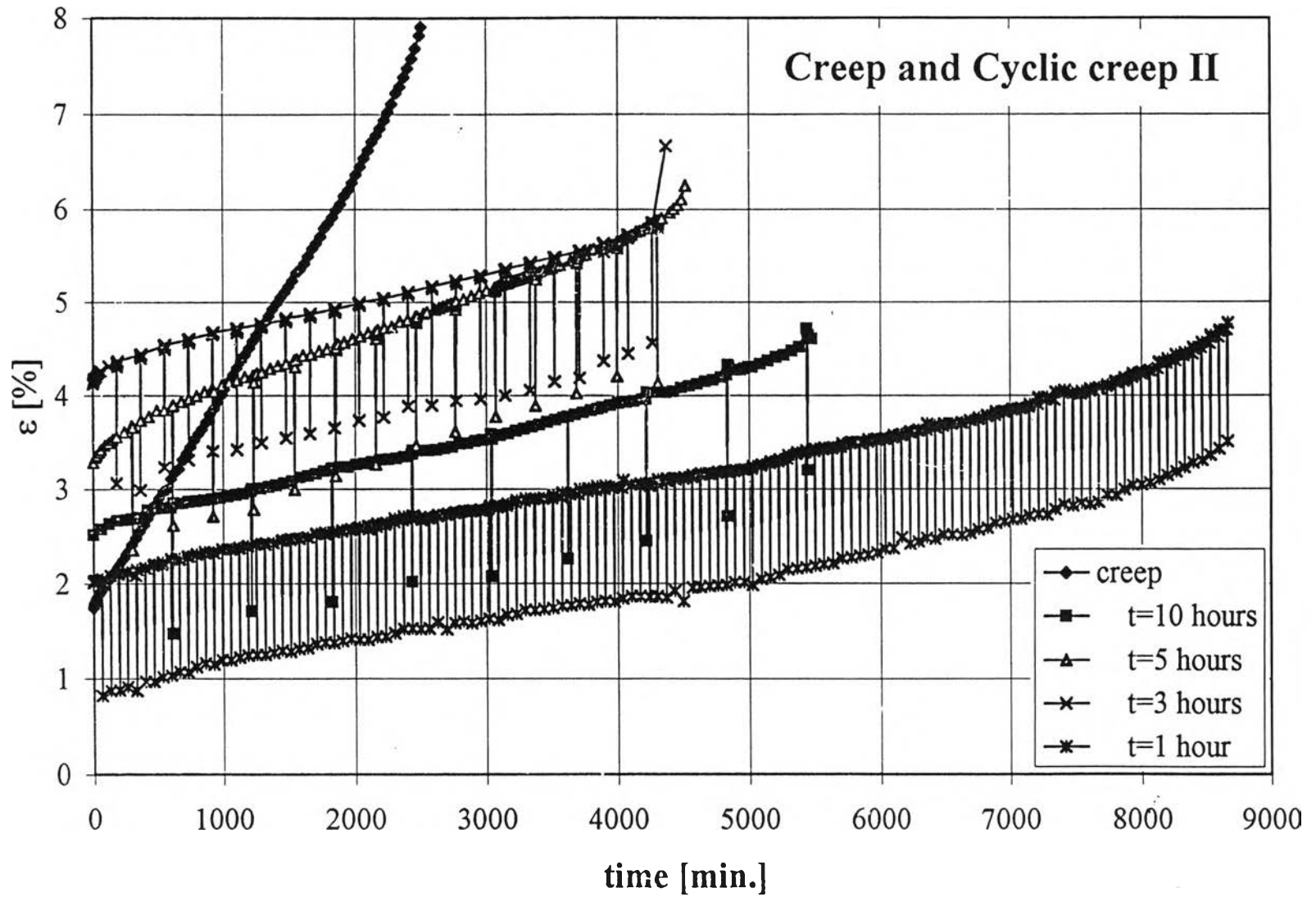
Cyclic creep I -  $\Delta t=5$  hoursCyclic creep I -  $\Delta t=10$  hours

Cyclic creep II -  $\Delta t=1$  hourCyclic creep II -  $\Delta t=3$  hours

Cyclic creep II -  $\Delta t=5$  hoursCyclic creep II -  $\Delta t=10$  hours







## BIOGRAPHY



Mr. Panyawat Wangyao was born on November 19, 1971 in Bangkok, Thailand. He finished his education in secondary school level at Suankularb College. Subsequently, he received a B.Eng. (Mechanical) from Kasetsart University in 1995. He began to study his master degree in Metallurgical Engineering at Chulalongkorn University in 1995.

He has all publication for both journals and conferences as following list:

- 1) J. Zrník, P. Wangyao, V. Vrchovinsky, P. Hornak. "Thermomechanical Fatigue of Wrought Nickel Base Superalloy" Euromat 97. Volume 1. 1997: 181-184.
- 2) J. Zrník, P. Wangyao, V. Vrchovinsky, P. Hornak and I. Mamuzic. "Deformation Behaviour of Wrought Nickel base Superalloy in Conditions of Thermomechanical Fatigue" Metalurgija.36/4. 1997: 225-228.
- 3) P. Wangyao, E. Nisaratanaporn, J. Zrník, V. Vrchovinsky, and P. Hornak. "High Temperature properties of Wrought Nickel base Superalloy in Creep-fatigue Conditions" Metal, Materials and Minerals. 7(1). 1997: 1-12.
- 4) J. Zrník, V. Vrchovinsky, P. Wangyao, P. Hornak, E. Nisaratanaporn. "TERMOMECHANICKA UNAVA TVARNENEJ NIKLOVE J SUPERZLIATINY" KONSTRUKCNE MATERIALY 97. 1997: 89-94.
- 5) J. Zrník, P. Wangyao, V. Vrchovinsky, P. Hornak. "VYSOKOTEPLOTNA DEFORMACIA NIKLOVE J SUPERZLIATINY V PODMIENKACH CYKLICKEHO CREEPU" Degradacia Vlastnosti Konstruckchych Materialov Unavov 97. 1997.

- 6) J. Zrník, P. Wangyao, V. Vrchovinsky, P. Hornak, E. Nisaratanaporn "Deformation Behaviour of Wrought Nickel base Superalloy Subjected to Isothermal Cyclic creep and thermomechanical fatigue" Fourth International Conference on Low Cycle Fatigue and Elasto- Plastic Behaviours of Materials. P.124. 1998.
- 7) J. Zrník, P. Wangyao, E. Nisaratanaporn. "Microstructure Study of Nickel Base Superalloy Subjected to Isothermal Cyclic Creep and Thermomechanical Fatigue loading Journal of Electron Microscopy Society of Thailand. Volume 12. 1998: PL1: 53.
- 8) ปัญญวัชร วังยาว, เอกสิทธิ์ นิสารัตนพร, โจเซฟ เซรอนนิค, วราดิเมียร์ เวระเดอะวินสกี, ปีเตอร์ ฮอนยัค "การศึกษาโครงสร้างจุลภาคของนิกเกิลเบสซูเปอร์อัลลอยด์ ที่ผ่านกระบวนการรีดร้อนภายใต้การแปรรูปในสภาวะผสมระหว่างความเค้นและความล้า" Materails Processing and manufacturing Conference 98, 1998. (To be published)