INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

A Monthly Double-Blind Peer Reviewed (Refereed/Juried) Open Access International e-Journal - Included in the International Serial Directories
Indexed & Listed at:
Ulrich's Periodicals Directory ©, ProQuest, U.S.A., EBSCO Publishing, U.S.A., Cabell's Directories of Publishing Opportunities, U.S.A.,
Open J-Gage, India [link of the same is duly available at Inflibnet of University Grants Commission (U.G.C.)],
Index Copernicus Publishers Panel, Polandwith IC Value of 5.09 &number of libraries all around the world.
Circulated all over the world & Google has verified that scholars of more than 2477 Cities in 159 countries/territories are visiting our journal on regular basis.
Ground Floor, Building No. 1041-C-1, Devi Bhawan Bazar, JAGADHRI – 135 003, Yamunanagar, Haryana, INDIA
http://ijrcm.org.in/

CONTENTS

CHIEF PATRON

PROF. K. K. AGGARWAL
Chancellor, Lingaya's University, Delhi
Founder Vice-Chancellor, GuruGobindSinghIndraprasthaUniversity, Delhi
Ex. Pro Vice-Chancellor, GuruJambheshwarUniversity, Hisar

FOUNDER PATRON

LATE SH. RAM BHAJAN AGGARWAL
Former State Minister for Home & Tourism, Government of Haryana
Former Vice-President, Dadri Education Society, Charkhi Dadri
Former President, Chinar Syntex Ltd. (Textile Mills), Bhiwani

CO-ORDINATOR

DR. SAMBHAV GARG
Faculty, Shree Ram Institute of Business & Management, Urjani

ADVISORS

DR. PRIYA RANJAN TRIVEDI
Chancellor, The Global Open University, Nagaland
PROF. M. S. SENAM RAJU
Director A. C. D., School of Management Studies, I.G.N.O.U., New Delhi
PROF. S. L. MAHANDRU
Principal (Retd.), MaharajaAgrasenCollege, Jagadhri

EDITOR

PROF. R. K. SHARMA
Professor, Bharti Vidyapeeth University Institute of Management & Research, New Delhi

EDITORIAL ADVISORY BOARD

DR. RAJESH MODI
Faculty, YanbuIndustrialCollege, Kingdom of Saudi Arabia
PROF. PARVEEN KUMAR
Director, M.C.A., Meerut Institute of Engineering & Technology, Meerut, U. P.
PROF. H. R. SHARMA
Director, Chhatarpati Shivaji Institute of Technology, Durg, C.G.
PROF. MANOHAR LAL
Director & Chairman, School of Information & Computer Sciences, I.G.N.O.U., New Delhi
PROF. ANIL K. SAINI
Chairperson (CRC), GuruGobindSinghI. P. University, Delhi
PROF. R. K. CHOUDHARY
Director, Asia Pacific Institute of Information Technology, Panipat
DR. ASHWANI KUSH
Head, Computer Science, UniversityCollege, KurukshetraUniversity, Kurukshetra

DR. BHARAT BHUSHAN
Head, Department of Computer Science & Applications, GuruNanakKhalsaCollege, Yamunanagar
DR. VIJAYPAL SINGH DHAKA
Dean (Academics), Rajasthan Institute of Engineering & Technology, Jaipur
DR. SAMBHAVNA
Faculty, I.I.T.M., Delhi
DR. MOHINDER CHAND
Associate Professor, KurukshetraUniversity, Kurukshetra
DR. MOHENDER KUMAR GUPTA
Associate Professor, P.J.L.N.GovernmentCollege, Faridabad
DR. SAMBHAV GARG
Faculty, Shree Ram Institute of Business & Management, Urjani
DR. SHIVAKUMAR DEENE
Asst. Professor, Dept. of Commerce, School of Business Studies, Central University of Karnataka, Gulbarga
DR. BHAVET
Faculty, Shree Ram Institute of Business & Management, Urjani

ASSOCIATE EDITORS

PROF. ABHAY BANSAL
Head, Department of Information Technology, Amity School of Engineering & Technology, Amity University, Noida
PROF. NAWAB ALI KHAN
Department of Commerce, AligarhMuslimUniversity, Aligarh, U.P.
ASHISH CHOPRA
Sr. Lecturer, Doon Valley Institute of Engineering & Technology, Karnal

TECHNICAL ADVISOR

AMITA
Faculty, Government M. S., Mohali

FINANCIAL ADVISORS

DICKIN GOYAL
Advocate & Tax Adviser, Panchkula
NEENA
Investment Consultant, Chambaghat, Solan, Himachal Pradesh

LEGAL ADVISORS

JITENDER S. CHAHAL
Advocate, Punjab & Haryana High Court, Chandigarh U.T.
CHANDER BHUSHAN SHARMA
Advocate & Consultant, District Courts, Yamunanagar at Jagadhri

SUPERINTENDENT

SURENDER KUMAR POONIA

CALL FOR MANUSCRIPTS

Weinvite unpublished novel, original, empirical and high quality research work pertaining to recent developments & practices in the area of Computer, Business, Finance, Marketing, Human Resource Management, General Management, Banking, Education, Insurance, Corporate Governance and emerging paradigms in allied subjects like Accounting Education; Accounting Information Systems; Accounting Theory & Practice; Auditing; Behavioral Accounting; Behavioral Economics; Corporate Finance; Cost Accounting; Econometrics; Economic Development; Economic History; Financial Institutions & Markets; Financial Services; Fiscal Policy; Government & Non Profit Accounting; Industrial Organization; International Economics & Trade; International Finance; Macro Economics; Micro Economics; Monetary Policy; Portfolio & Security Analysis; Public Policy Economics; Real Estate; Regional Economics; Tax Accounting; Advertising & Promotion Management; Business Education; Management Information Systems (MIS); Business Law, Public Responsibility & Ethics; Communication; Direct Marketing; E-Commerce; Global Business; Health Care Administration; Labor Relations & Human Resource Management; Marketing Research; Marketing Theory & Applications; Non-Profit Organizations; Office Administration/Management; Operations Research/Statistics; Organizational Behavior & Theory; Organizational Development; Production/Operations; Public Administration; Purchasing/Materials Management; Retailing; Sales/Selling; Services; Small Business Entrepreneurship; Strategic Management Policy; Technology/Innovation; Tourism, Hospitality & Leisure; Transportation/Physical Distribution; Algorithms; Artificial Intelligence; Compilers & Translation; Computer Aided Design (CAD); Computer Aided Manufacturing; Computer Graphics; Computer Organization & Architecture; Database Structures & Systems; Digital Logic; Discrete Structures; Internet; Management Information Systems; Modeling & Simulation; Multimedia; Neural Systems/Neural Networks; Numerical Analysis/Scientific Computing; Object Oriented Programming; Operating Systems; Programming Languages; Robotics; Symbolic & Formal Logic and Web Design. The above mentioned tracks are only indicative, and not exhaustive.

Anybody can submit the soft copy of his/her manuscript **anytime** in M.S. Word format after preparing the same as per our submission guidelines duly available on our website under the heading guidelines for submission, at the email address: infoijrcm@gmail.com.

GUIDELINES FOR SUBMISSION OF MANUSCRIPT

1. COVERING LETTER FOR SUBMISSION:

DATED: _____________

THE EDITOR
IJRCM

Subject: **SUBMISSION OF MANUSCRIPT IN THE AREA OF .**

(e.g. Finance/Marketing/HRM/General Management/Economics/Psychology/Law/Computer/IT/Engineering/Mathematics/other, please specify)

DEAR SIR/MADAM

Please find my submission of manuscript entitled '____' for possible publication in your journals.

I hereby affirm that the contents of this manuscript are original. Furthermore, it has neither been published elsewhere in any language fully or partly, nor is it under review for publication elsewhere.

I affirm that all the author (s) have seen and agreed to the submitted version of the manuscript and their inclusion of name (s) as co-author (s).

Also, if my/our manuscript is accepted, I/We agree to comply with the formalities as given on the website of the journal & you are free to publish our contribution in any of your journals.

NAME OF CORRESPONDING AUTHOR:
Designation:
Affiliation with full address, contact numbers & Pin Code:
Residential address with Pin Code:
Mobile Number (s):
Landline Number (s):
E-mail Address:
Alternate E-mail Address:

NOTES:

a) The whole manuscript is required to be in ***ONE MS WORD FILE*** only (pdf. version is liable to be rejected without any consideration), which will start from the covering letter, inside the manuscript.
b) The sender is required to mentionthe following in the **SUBJECT COLUMN** of the mail:
New Manuscript for Review in the area of (Finance/Marketing/HRM/General Management/Economics/Psychology/Law/Computer/IT/Engineering/Mathematics/other, please specify)
c) There is no need to give any text in the body of mail, except the cases where the author wishes to give any specific message w.r.t. to the manuscript.
d) The total size of the file containing the manuscript is required to be below **500 KB**.
e) Abstract alone will not be considered for review, and the author is required to submit the complete manuscript in the first instance.
f) The journal gives acknowledgement w.r.t. the receipt of every email and in case of non-receipt of acknowledgment from the journal, w.r.t. the submission of manuscript, within two days of submission, the corresponding author is required to demand for the same by sending separate mail to the journal.

2. MANUSCRIPT TITLE: The title of the paper should be in a 12 point Calibri Font. It should be bold typed, centered and fully capitalised.

3. AUTHOR NAME (S) & AFFILIATIONS: The author (s) **full name**, **designation**, **affiliation** (s), **address**, **mobile/landline numbers**, and **email/alternate email address** should be in italic & 11-point Calibri Font. It must be centered underneath the title.

4. ABSTRACT: Abstract should be in fully italicized text, not exceeding 250 words. The abstract must be informative and explain the background, aims, methods, results & conclusion in a single para. Abbreviations must be mentioned in full.

5. **KEYWORDS**: Abstract must be followed by a list of keywords, subject to the maximum of five. These should be arranged in alphabetic order separated by commas and full stops at the end.

6. **MANUSCRIPT**: Manuscript must be in ***BRITISH ENGLISH*** prepared on a standard A4 size ***PORTRAIT SETTING PAPER***. It must be prepared on a single space and single column with 1" margin set for top, bottom, left and right. It should be typed in 8 point Calibri Font with page numbers at the bottom and centre of every page. It should be free from grammatical, spelling and punctuation errors and must be thoroughly edited.

7. **HEADINGS**: All the headings should be in a 10 point Calibri Font. These must be bold-faced, aligned left and fully capitalised. Leave a blank line before each heading.

8. **SUB-HEADINGS**: All the sub-headings should be in a 8 point Calibri Font. These must be bold-faced, aligned left and fully capitalised.

9. **MAIN TEXT**: The main text should follow the following sequence:

   INTRODUCTION

   REVIEW OF LITERATURE

   NEED/IMPORTANCE OF THE STUDY

   STATEMENT OF THE PROBLEM

   OBJECTIVES

   HYPOTHESES

   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

   RECOMMENDATIONS/SUGGESTIONS

   CONCLUSIONS

   SCOPE FOR FURTHER RESEARCH

   ACKNOWLEDGMENTS

   REFERENCES

   APPENDIX/ANNEXURE

   It should be in a 8 point Calibri Font, single spaced and justified. The manuscript should preferably not exceed ***5000 WORDS***.

10. **FIGURES &TABLES**: These should be simple, crystal clear, centered, separately numbered &self explained, and **titles must be above the table/figure**. **Sources of data should be mentioned below the table/figure**. It should be ensured that the tables/figures are referred to from the main text.

11. **EQUATIONS**:These should be consecutively numbered in parentheses, horizontally centered with equation number placed at the right.

12. **REFERENCES**: The list of all references should be alphabetically arranged. The author (s) should mention only the actually utilised references in the preparation of manuscript and they are supposed to follow **Harvard Style of Referencing**. The author (s) are supposed to follow the references as per the following:

- All works cited in the text (including sources for tables and figures) should be listed alphabetically.
- Use (**ed.**) for one editor, and (**ed.s)** for multiple editors.
- When listing two or more works by one author, use --- (20xx), such as after Kohl (1997), use --- (2001), etc, in chronologically ascending order.
- Indicate (opening and closing) page numbers for articles in journals and for chapters in books.
- The title of books and journals should be in italics. Double quotation marks are used for titles of journal articles, book chapters, dissertations, reports, working papers, unpublished material, etc.
- For titles in a language other than English, provide an English translation in parentheses.
- The location of endnotes within the text should be indicated by superscript numbers.

PLEASE USE THE FOLLOWING FOR STYLE AND PUNCTUATION IN REFERENCES:

BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

UNPUBLISHED DISSERTATIONS AND THESES

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, KurukshetraUniversity, Kurukshetra.

ONLINE RESOURCES

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

WEBSITES

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

HEAT TRANSFER ENHANCEMENT IN AIR CONDITIONING SYSTEM USING NANOFLUIDS

R. REJI KUMAR
LECTURER
SCHOOL OF MECHANICAL & INDUSTRIAL ENGINEERING
BAHIR DAR UNIVERSITY
BAHIR DAR

M. NARASIMHA
LECTURER
SCHOOL OF MECHANICAL & INDUSTRIAL ENGINEERING
BAHIR DAR UNIVERSITY
BAHIR DAR

K. SRIDHAR
LECTURER
SCHOOL OF MECHANICAL & INDUSTRIAL ENGINEERING
BAHIRDAR UNIVERSITY
BAHIRDAR

ABSTRACT

The experimental apparatus was build according to the National Standards of India. For providing comfort condition, the air conditioning system uses refrigerant for heat transfer. The performance of the air conditioning system depends upon the heat transfer capacity of the refrigerant. Normally R12, R22 are used as a refrigerant. This refrigerant heat transfer capacity is not so good and increase power consumption. Due to these limitation nanofluids are enhanced with the normal refrigerant and increases the heat transfer capacity and reduces the power consumption. Titanium dioxide nanofluid is used for enhancing the heat transfer capacity of the refrigerant in the air conditioning System. In this experiment heat transfer enhancement was investigated numerically on the surface of a air conditioner by using TiO_2-R22 refrigerants where nanofluids could be a significant factor in maintaining the surface temperature within a required range. The air conditioner performance was then investigated by operating the unit continuously for 24 hours. In the case of air conditioner a series of parametric studies is presented in order to examine the effects of important parameters such as compressor suction pressure, discharge pressure and evaporation temperature. It is found that nanofluid is used to increase in thermal conductivity, improve heat transfer stability, saving of power consumption and minimal clogging. Thus using TiO_2 -R22 nano-refrigerant in air conditioning system is feasible.

KEYWORDS

Air conditioner test rig, Nano- refrigerant, TiO_2 nanoparticle, Thermal conductivity, Viscosity, R22, Heat rejection ratio, Energy consumption.

LIST OF SYMBOLS

Symbol	Description	Unit
Nomenclature		
A	Cross sectional area	m^2
C_p	Specific heat	J/Kg k
D	Diameter	m
h	Heat transfer coefficient	$w/m^2 k$
K_m	Thermal conductivity of base refrigerant	w/m k
K_2	Thermal conductivity of nanoparticle	w/m k
m	Mass flow rate	Kg/s
T	Temperature	° C
v	Velocity	m/s
n	Particle shape factor	
n_f	Nanofluid	
Greek symbols		
υ	Mass fraction	
ρ_f	Density of refrigerant	Kg/m^3
ρ_p	Density of nanoparticle	Kg/m^3
μ	Dynamic viscosity	Kg/ms
ψ	Sphericity	
Abbreviation		
HTC	Heat transfer coefficient	
TR	Tonne of refrigeration	

1. INTRODUCTION

Nano refrigerant was proposed on the basis of the concept of the nanofluids, which was prepared by mass fraction of nanoparticles and traditional refrigerant.

The air conditioning is that branch of engineering science which deals with the study of conditioning of air is supplying and maintaining desirable internal atmospheric conditions for human comfort irrespective of external conditions. In air conditioning system the space to be cooled or heated by way of transferring heat from the place to another. Air conditioning in homes may account for up to one third of electricity use during periods in the summer when the most energy is required in large cities, according to a study carried out by carlos III University of Madrid (UC3M) and the Consejo Superior de investigations Scientific as (Spanish national research Council- CSIC)[1]. Sometimes the peak electric supply cannot meet the load demands for air conditioning systems. Regarding this issue, thermal storage use secondary refrigerants of phase change materials can relieve or eliminate the peak electric power load for buildings [2-4]. In addition , also the nano -refrigerants/fluids can reduce power consumption by enhanced heat transfer characteristic. They can also relieve the issue of sedimentation, erosion, clogging and high pressure drop caused by the particles use.

2. LITERATURE SURVEY

Nano-refrigerant was proposed on the basis of the concept of the nanofluids, which was prepared by mixing the nanoparticles and traditional refrigerant. There were three main advantages followed for the nanoparticle used in the air conditioner.

Firstly, nanoparticles can enhance the solubility between the lubricant and the refrigerant. For example, Wang and Xie [5] found that TiO_2 nanoparticles could be used as additives to enhance the solubility between mineral oil and hydrofluorocarbon (MFC) refrigerant. The refrigeration systems using the mixture of R134a and mineral oil appended with nanoparticles TiO_2, appeared to give better performance by returning more lubricant oil back to the compressor, and had the similar performance compared to the systems using polyol-ester (POE) and R134a.

Secondly, the thermal conductivity and heat transfer characteristics of the refrigerants should be increased, which have been approved by a lot of investigations. For instance, Jiang et al. [6] measured the thermal conductivities of CNT-R113 nano-refrigerants and found that the measured thermal conductivities of four kinds of l.0 vol.% CNT-R113 nano-refrigerants increase 82%, 104%, 43% and 50%, respectively. Wang et al. [7] carried out an experimental study of boiling heat transfer characteristics of $A1_2O_3$ nanoparticles dispersed in R22 refrigerant, and found that nanoparticles can enhance the heat transfer characteristic of the refrigerant, and the bubble size diminish and move quickly near the heat transfer surface. Wu et al. [8] investigated the pool boiling heat transfer of the Rl1 refrigerant mixed with nanoparticles TiO_2, and the results indicated that the heat transfer enhancement reached 20% at a particle loading of 0.01 g/L. Park and Jung [9] investigated the effect of carbon nanotubes (CNTs) on nucleate boiling heat transfer of halocarbon refrigerants of R123 and R134a. Test results showed that CNTs increase nucleate boiling heat transfer coefficients for these refrigerants. Especially, large enhancement up to 36.6% was observed at low heat fluxes of less than 30 KW/m^2. Peng et al. [10] found that the heat transfer coefficient of CuO-R113 was larger than that of pure refrigerant R113, and the maximum enhancement of heat transfer coefficient was 29.7%. Ding et al. [11] investigated the migrated mass of nanoparticles in the pool boiling process of both nano-refrigerant and nano-refrigerant-oil mixture, and found that the migrated mass of nanoparticles and migration ratio in the nano-refrigerant were larger than those in the nano-refrigerant-oil mixture.

Finally, nanoparticles dispersed in lubricant should decrease the friction coefficient and wear rate. Lee at al. [12] investigated the friction coefficient of the mineral oil mixed with 0.1 vol.% fullerene nanoparticles, and the results indicated that the friction coefficient decreased by 90% in comparison with raw lubricant, which lead us to the conclusion that nanoparticles can improve the efficiency and reliability of the compressor. Jwo et al. [13] carried out the performance experiment of a domestic refrigerator using hydrocarbon refrigerant and 0.1 wt.% Al_2O_3-mineral oil as working fluid, the results indicated that the power consumption was reduced by about 2.4%, and the coefficient of performance was increased by 4.4%.

In the previous work, the author has investigated the basic characteristics of the TiO_2-Rl34a nano-refrigerants, including the dispersion behavior [14], thermal conductivity and flow boiling heat transfer [15,16]. The performance of a domestic refrigerator with nanoparticles added was also investigated. In the former experiment, the nanoparticles were added into the refrigeration system in two different ways. In one way the nanoparticles were added to the refrigeration system by first adding them into the lubricant to make a nanoparticle-lubricant mixture. Then, the mixtures were put into the compressor as the lubricant [17]. In the other way nanoparticles and traditional refrigerant were mixed directly to make nano-refrigerant [18]. The results of both of the ways had showed the better performance of the air conditioner with nanoparticles added.

Mono Chloro DiFluoro Methane (R22) is more widely adopted in air conditioner because of its better environmental and energy performances. In this paper, a new air conditioner test rig system was built up according to the National Standard of India. A air conditioner R22 system was selected. TiO_2-R22 nano-refrigerant was prepared and used as working fluid. The energy consumption test and cop test were conducted to compare the performance of the air conditioner with nano-refrigerant and pure refrigerant so as to provide the basic data for the application of the nanoparticles in the air conditioning system.

In the project the base fluid is Difluoro mono chloro methane CHF_2Cl (R22.). To enhance the heat transfer rate of the above said base fluid the nanoparticle TiO_2 is chosen. The properties of the nanofluids are calculated by formulas. The thermo physical properties of Difluoro mono chloro methane, Titanium dioxide are tabulated and it is substituted in the formulas for finding the properties of nanofluids. In order to analyze the heat transfer rate and the power consumption of the base refrigerant and nano refrigerant were calculated by experimental methods. And also a comparative work done is done between the thermal conductivity models namely Maxwell, Hamilton, crosser, Jeffrey, Davis, Bruggeman models.

3. PHYSICAL PROPERTICS OF NANOFLUIDS

3.1. THERMOPHYSICAL PROPERTIES OF BASE REFRIGERANT

Its numerical designation is R22 or CFC-22 or F22. It is an organic refrigerant comes under methane series. It is a derivative of saturated hydro carbons of HCFCs group. R22 is a man-made refrigerant developed for refrigeration installations that need a low evaporating temperature, as in fact freezing of -19^{o}c to -40^{o}c. It is used reciprocating and centrifugal compressors.

Normal boiling point = –40.8^{o}Cat atm pressure
Freezing point = –160^{o}C
Critical Temperature = 96^{o}C
Critical presser = 49.38 bar
Evaporative Pressure = 2.967 bar at – 15^{o}C
Condenser pressure = 12.034 bar at 30^{o}C
Compression ratio = 4.05
Latent heat = 216.5 kJ/kg at -15^{o}C
Specific heat at con. Pressure C_p = 0.980 J/kgK
Density = 1413 Kg/m^3
Specific heat ratio (C_p/C_v) = 1.16
Coefficient of performance = 4.66
Thermal conductivity = 0.0715 w/mk at 40^{o}C
Viscosity = 0.00001256 Kg/ms
Ozone depleting potential (ODP) = 0.07
Global Warming potential (GWP) = 1700
Atmospheric life data = 15years
Total phase out data = 1st January 2030

Assigned colour code = Light green

Properties

Stable at high temperature
Non flammable
Non explosive
Non irritating
Good stability in oil
Leaks may be easily detected

3.2. THERMOPHYSICAL PROPERTIES OF NANOPARTICLES

Its molecular formula is TiO_2.

Melting Point = 1843°C
Boiling Point = 2972°C
Flash Point = Non flammable
Colour = White pigment
Density = 4.23 kg/m^3 at 20°C
Specific heat at con. Pressure C_p: = 711 J/kgK
Thermal conductivity = 11.7 w/mk
Molecular mass = 9.9 g/mol
Specific Surface Area = 35-65m^2/g
Average Primary Particle size = 50nm
Appearance = White powder
Composition = 70% Anatase, 30% Rutile
Specific gravity = 4.26

PROPERTIES

It is insoluble in water.
Stable under normal, temperature and pressures.
It is non combustible.
It is odorless.

3.3. THERMOPHYSICAL PROPERTIES OF NANOFLUID

3.3.1.Density

The density of nanofluid can be calculated by using mass balance as.

$\rho_{nf} = (1 - \upsilon_s)\,\rho_f + \upsilon_s\,\rho_p$ ________________(3.1)

Using the above equation one can predict the small decreases in density will typically result when solid particles are dispersed in liquids.

3.3.2. Specific heat

The specific heat of nanofluid can be calculated by using mass balance as:

$$C_{nf} = \frac{(1-\upsilon_s)\rho_f c_f + \upsilon_s \rho_p c_p}{\rho_{nf}} \qquad \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(3.2)$$

Using the above equation one can predict the small decreases in specific heat will typically result when solid particles are dispersed in liquids.

3.13. Dynamic Viscosity

The effective dynamic viscosity of nanofluid can be calculated using obtained for two phase mixtures. It cab be calculated as.

$\mu = \mu_o (123\upsilon_s^2 + 7.3\upsilon_s + 1)$ ________ (3.3)

3.3.4. Thermal Conductivity

Many theoretical and empirical models have been proposed to predict the effective thermal conductivity of nano-refrigerants. The commonly used models are listed below with their formulas.

The expressions of the conventional models of the effective thermal conductivity of a solid/liquid suspension are as follows:

- Maxwell

$$\frac{k_{eff}}{k_m} = 1 + \frac{3(\alpha-1)\upsilon}{(\alpha+2)-(\alpha-1)\upsilon} \qquad \_\_\_\_\_\_\_\_(3.4)$$

- Hamilton and Crosser

$$\frac{k_{eff}}{k_m} = \frac{\alpha+(n-1)-(n-1)1-\alpha)\upsilon}{a+(n-1)+(1-\alpha)\upsilon} \qquad \_\_\_\_\_\_(3.5)$$

Where n depends of particle shape factor given by
$n = 3/\psi$ for
$K_2 / K_m > 100$.
ψ = sphericity ($\psi = 1$ for spherical particles)
n = 3 for other cases

- Jeffery

$$\frac{k_{eff}}{k_m} = 1 + 3\beta\upsilon + \left(3\beta^2 + \frac{3\beta^2}{4} + \frac{9\beta^3}{16}\,\frac{\alpha+2}{2\alpha+3} + \ldots\right)\upsilon^2 \qquad \_\_(3.6)$$

- Davis

$$\frac{k_{eff}}{k_m} = 1 + \frac{3(\alpha-1)}{(\alpha+2)-(\alpha-1)\upsilon}[\upsilon + f(\alpha)\upsilon^2 + 0(\upsilon^3)] \qquad \_\_\ (3.7)$$

- Bruggeman model

$$\frac{k_{eff}}{k_m} = \frac{[(3r-1)\times\alpha + (2-3v) + \Delta^{0.5}]}{4} \qquad \_\_\_\_\_\_\_\_(3.8)$$

$\Delta = (3\upsilon-1)^2\,\alpha^2 + (2-3\upsilon^2) + 2(2+9v-9\upsilon^2)\alpha$

Where k_{eff} is the effective thermal conductivity of solid/liquid suspensions, k_m and k_2 are the thermal conductivity of the base fluid and particle, respectively, n and υ are the particle shape factor and particle volume fraction, respectively, and $\alpha = k_2/k_m$, $\beta = (\alpha - 1)/(\alpha + 2)$. All the existing theoretical models and theories are only depended on the thermal conductivity of the solid and liquid and their relative volume fraction, not on the particle size and interface between the particles and fluid.

Using the formula in equation 3.4 to 3.8 the thermal conductivity is calculated for nanoparticles percentages from 0.1 to 30 for all six models.

Nano refrigerants containing small amounts of nanoparticles have substantially higher thermal conductivity than those of base refrigerants.

4. EXPERIMENTAL SETUP AND TEST PROCEDURE

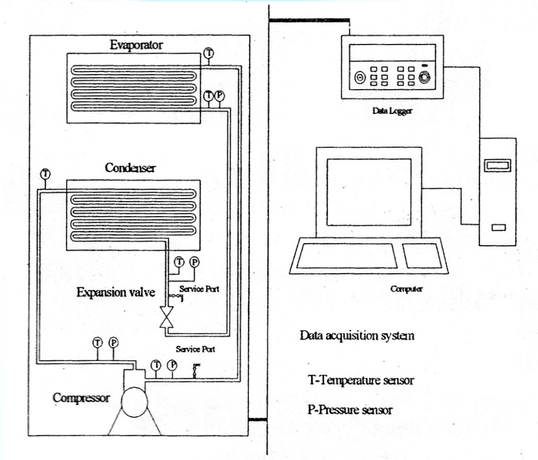
This section provides a description of the facilities developed for conduction experimental work on a Air Conditioner. The technique of charging and Evacuation of the system is also discussed here.

4.1. EXPERIMENTAL METHODOLOGY

The temperature of the refrigerant inlet/outlet of each component of the refrigerator was measured with copper – constantan thermocouples (T type). The thermocouple sensors fitted at inlet and outlet of the compressor, condenser, and thermocouples/temperature sensors were interfaced with a HP data logger via a PC through the GPIB cable for data storage. Temperature measurement is necessary to find out the enthalpy in and out of each component of the system to, investigate the performance. The inlet and outlet pressure of refrigerant for each of the component is also necessary to find out their enthalpy at corresponding state.

The pressure transducer was fitted at the inlet and outlet of the compressor and expansion valve as shown in Fig.1. The pressure transducers were fitted with the T-joint and then brazed with the tube to measure the pressure at desired position. The range of the pressure transducer is -1 to + 39 bars. The pressure transducers also been interfaced with computer via data logger to store data. A service port was installed at the inlet of expansion valve and compressor for charging and recovering the refrigerant. The location of the service port is shown in Fig. 1. The evacuation has also been carried out through this service port. A power meter was connected with compressor to measure the power and energy consumption.

FIG. 1



4.2. PREPARATION OF THE TiO_2- R22 NANOFLUID

Nano-refrigerant was prepared in a recommended method for nanofluid, the nanoparticles were mixed into the refrigerant and then the mixture was kept vibrated with an ultrasonic oscillator to fully separate nanoparticles. The purity of the R22 used in the tests, which was supplied by the Dupont Company, was higher than 99.8%. The TiO_2 nanoparticles were provided by Zhejiang Hongsheng Nanotech Co. Ltd. The average particle diameters were about 50nm and the mass purity was purity was about 99.5%. The nanoparticles masses were measured on an AB204-N balance manufactured by Mettler (Switzerland) with a precision of 0.1 mg.

The stability of the nano-refrigerant was an important and basic problem, on the basis of the former study on the dispersion of nanoparticles in the refrigerant, 0.1 and 0.5 g/L concentration were selected for the further investigations.

4.3. SYSTEM EVACUATION

Moisture combines in varying degree with most of the commonly used refrigerants and reacts with the lubricating oil and with other materials in the system, producing highly corrosive compound.

The resulting chemical reaction often produces pitting and other damage on the valves seals, cylinder wall and other polished surface of the system. It may cause the deterioration of the lubricating oil and the formation of sludge that can gum up valves, clog oil passages, score bearing surface and produce other effect that reduce the life of the system. Moisture in the system may exist in solution or as free water. Free water can freeze into the ice crystals inside the metering device and in the evaporator tubes of system that operate below the freezing point of the water. This reaction is called freeze up. When freeze up occurs, the formation of ice within the orifice of the metering device temporarily stops the flow of the liquid refrigerant .

To get rid of the detrimental effect of moisture Yellow jacket 4cfm vacuum pump was used to evacuate the system. This system evacuates fast and better which is deep enough to get rid of contaminant that could cause system failure.. The hoses were connected with the service port to remove the moisture from the system. When the pump is turned on the internal the pressure gauge shows the pressure inside the refrigerator system.

4.4. SYSTEM CHARGING

Yellow jacket digital electronic charging scale has been used to charges R22 and TiO_2- R22 into the system. This is an automatic digital charging system that can charge the desired amount accurately and automatically.

The charging system consists of a platform, an LCD, an electronic controlled valve and charging hose. The refrigerant cylinder was placed on the platform which measures the weight of the cylinder. The LCD displays the weight and also acts as a control panel. One charging hose was connected with the outlet of the cylinder and inlet of the electronic valve and another one was connected with the outlet of electronic valve and inlet of the service port. Using this charging system refrigerants were charged into the system according to desired amount.

4.5. TEST PROCEDURE

The system was evacuated with the help of vacuum pump to remove the moisture and charged with the help of charging system. The pressure transducers and thermocouples fitted with the system were connected with the data logger. The data logger was interfaced with the computer and software has been installed to operate the data logger from the computer and to store the data. The data logger was set to scan the data from the temperature sensor and pressure sensor at an interval of 30 seconds. A power meter was connected with the refrigerator and interfaced with the computer and power meter software was installed. The power meter stores the instantaneous power and cumulative energy consumption of the refrigerator and cumulative energy consumption of the air conditioner. The pressures and temperatures of the refrigerants from the data logger were used to determine the enthalpy of the refrigerant. All equipments and test unit was installed inside the environment control chamber where the temperature and humidity was controlled. The dehumidifier has been used to maintain desired level of humidity at the control chamber. The experiment has been conducted of the air-conditioning test rig.

5. WORKING PRINCIPLE

The experimental apparatus was build according to the National Standards of India. The testing environment is at room temperature. Air conditioning unit's place in a room at constant room temperature. The temperature of room is cooled by normal refrigerant R22 and data's are collected. Then by adding nanofluids Titanium oxide (TiO_2) by volume and mass fraction the working performance of air condition unit is analyzed.

During the study the performance of energy consumption, cooling performance are measured by operating the unit under a steady operating conditions. During performance test the operating parameters were recorded such as compression suction pressure, discharge pressure, air inlet dry bulb temperature, wet bulb temperature, air outlet dry bulb temperature, wet bulb temperature are noted and adding nano-refrigerants variations in parameters are noted with different percentage addition of nano- refrigerant along with usual refrigerant.

6. RESULTS AND DISCUSSION

The comparison of the performance parameters of the refrigerants and energy consumption by the air conditioner is discussed in this section. The comparison of energy consumption and performance is given below for pure R22 Refrigerant and TiO_2–R22 refrigerant.

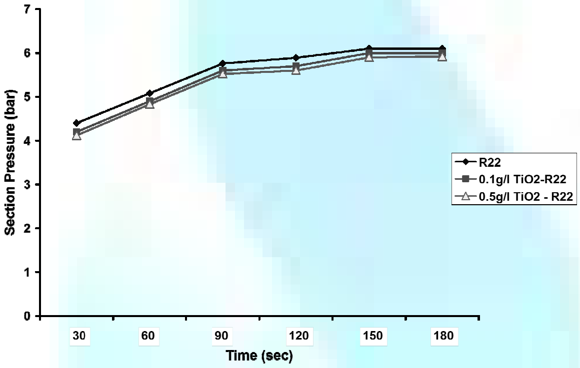
6.1. ENERGY CONSUMPTION BY THE COMPRESSOR

The energy consumption by the compressor during on hours was measured and stored is computer. The test was carried out maintain a temperature of 14^{o}C. The energy consumption by the air condition is presented in the table.

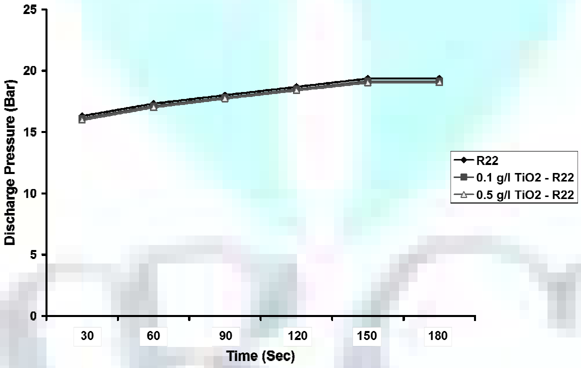
ENERGY CONSUMPTION RESULTS

Concentration g/l	0	0.1	0.5
Energy consumption kw/hr	0.06	0.055	0.053
Energy saving %	-	8.3	11.66

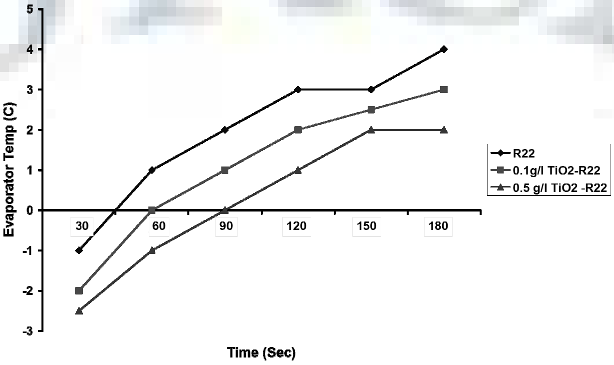
6.2. EFFECT OF SUCTION PRESSURE VS TIME



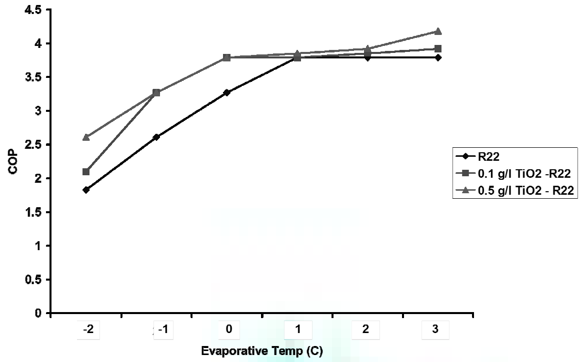
6.3. EFFECT OF DISCHARGE PRESSURE VS TIME



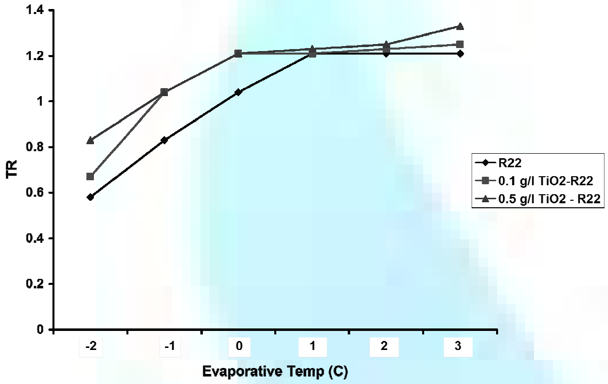
6.4. EFFECT OF EVAPORATOR TEMPERATURE VS TIME



6.5. EFFECT OF EVAPORATOR TEMPERATURE VS COP



6.6 EFFECT OF EVAPORATOR TEMPERATURE VS TR



7. CONCLUSION

In this project TiO_2-R22 nano-refrigerants were used as a working fluid of air conditioning. The results indicated that TiO_2-R22 can work normally and efficiently in air conditioner compared with air conditioner using pure R22 as a working fluids, 0.1 and 0.5 g/l concentrations of TiO_2-R22 can save 8.3 and 11.66 % energy consumption respectively. In addition the results were similar to the author's early research of using TiO_2-134a as a working fluids. So the above work have demonstrated that nanoparticles can improve the performance and save the energy consumption of the air conditioner.

8. REFERENCES

1. Air Conditioning Consumes One Third of Peak Electric Consumption in the Summer. http://www.sciencedaily.com/releases/2012/10/121022080408.htm 2012.
2. Bi SS, Shi L, Zhang LL. Application of nanoparticles in domestic refrigerators. Appl Therm Eng 2008;28:1834–43.
3. Bi SS, Shi L. Dispersion behavior of nanoparticles in refrigerant. J Eng Thermophys 2007;28:185–8.
4. Bi SS, Shi L. Experimental investigation of a refrigerator with a nano refrigerant. J Tsinghua Univ (Sci Tech) 2007;47:1999–2002.
5. Bi SS, Shi L.Flow boiling heat transfer nano-refrigerant TiO2 and HFC134a mixtures in a horizontal tube. J Chem Indus Eng 2009;59:104 –8.
6. Bi SS, Wu JT, Shi L. The thermal conductivity of the nanoparticles TiO2 and R134a mixtures. J Eng Thermophys 2008;29:205–7.
7. Ding GL, Peng H, Jiang WT, et al. The migration characteristics of nanoparticles in the pool boiling process of nanorefrigerant and nanorefrigerant–oil mixture. Int J Refrig 2009;32:114–23.
8. Gang Li, Daoping Liu, Yingming Xie. Study on thermal properties of TBAB-THF hydrate mixture for cold storage by DSC. Journal of Thermal Analysis and Calorimetry. 2010,102(2): 819-826.
9. Gang Li, Yunho Hwang, Reinhard Radermacher, Ho-Hwan Chun.Review of cold storage materials for subzero applications. Energy. DOI: 2012. 10.1016/j.energy.2012.12.0025. Available online 8 January 2013
10. Gang Li, Yunho Hwang, Reinhard Radermacher. Review of cold storage materials for air conditioning application. International Journal of Refrigeration. 2012,35: 2053-2077
11. GB/T 8059.1–3-1995, China refrigeration and air-conditioning standard, Standards Press of China; 2002.
12. Jiang WT, Ding GL, Peng H. Measurement and model on thermal conductivities of carbon nanotube nanorefrigerants. Int J Therm Sci 2009;48:1108–15.
13. Jwo CS, Jeng LY, Teng TP, Chang H. Effects of nanolubricant on performance of hydrocarbon refrigerant system. J Vac Sci Technol B 2009;27:1473–7, ISSN:1071–1023.
14. Lee K, Hwang YJ, Cheong S, Kwon L, Kim S, Lee J. Performance evaluation of nano-lubricants of fullerene nanoparticles in refrigeration mineral oil. Curr Appl Phys 2009;9:128–31.
15. Park KJ, Jung DS. Boiling heat transfer enhancement with carbon nanotubes for refrigerants used in building air-conditioning. Energy Build 2007;39:1061–4.
16. Peng H, Ding GL, Jiang WT, et al. Heat transfer characteristics of refrigerant based nanofluid flow boiling inside a horizontal smooth tube. Int J Refrig 2009;32:1259–70.
17. Wang KJ, Ding GL, Jiang WT. Nano-scale thermal transporting and its use in engineering. In: Proceedings of the 4th symposium on refrigeration and air condition, Southeast University; 2006.
18. Wang RX, Xie HB. A refrigerating system using HFC134a and mineral lubricant appended with N-TiO2(R) as working fluids. In: Proceedings of the 4th international symposium on HAVC, Tsinghua University; 2003.
19. Wu XM, Li P, Li H, et al. Investigation of pool boiling heat transfer of R11 with TiO2 nano-particle. J Eng Thermophys 2008;28:124–6.

REQUEST FOR FEEDBACK

Dear Readers

At the very outset, International Journal of Research in Computer Application and Management (IJRCM) acknowledges & appreciates your efforts in showing interest in our present issue under your kind perusal.

I would like to request you tosupply your critical comments and suggestions about the material published in this issue as well as on the journal as a whole, on our E-mail**infoijrcm@gmail.com** for further improvements in the interest of research.

If youhave any queries please feel free to contact us on our E-mail infoijrcm@gmail.com.

I am sure that your feedback and deliberations would make future issues better – a result of our joint effort.

Looking forward an appropriate consideration.

With sincere regards

Thanking you profoundly

Academically yours

Sd/-

Co-ordinator

ABOUT THE JOURNAL

In this age of Commerce, Economics, Computer, I.T. & Management and cut throat competition, a group of intellectuals felt the need to have some platform, where young and budding managers and academicians could express their views and discuss the problems among their peers. This journal was conceived with this noble intention in view. This journal has been introduced to give an opportunity for expressing refined and innovative ideas in this field. It is our humble endeavour to provide a springboard to the upcoming specialists and give a chance to know about the latest in the sphere of research and knowledge. We have taken a small step and we hope that with the active co-operation of like-minded scholars, we shall be able to serve the society with our humble efforts.

Our Other Journals