IRG Activity Report

Date of Submission: 10/8/2010

1. IRG code and name of IRG

1) IRG code: IRG -08 - 2005

2) Name of IRG: Research on the control mechanism and simulation of safety conditions of perishable foods transportation and logistics

2. List of research members

- P.R.China:

1) Xie Ruhe (Representative)
Professor, Ph.D., Research Center for Logistics and Transportation, Guangzhou University

2) Liu Guanghai
Ph.D., Director, Research Center for Logistics and Transportation, Guangzhou University

3) Zou Yifeng
Ph.D., Research Center for Logistics and Transportation, Guangzhou University

4) Huang Xiangrong
Research Center for Logistics and Transportation, Guangzhou University

- England

1) Alan Foster
Research Fellow, Faculty of Engineering, Science and the Built Environment, London South Bank University

- Taiwan District

1) Cheng-Min Feng
Institute of Traffic and Transportation, National Chiao Tung University

3. Purpose and Mission of IRG

The present goal is to study Food Logistics Technical Conditions.

Cold-chain is a system engineering to ensure the quality and reduce the loss of foods during production, storage, transportation, distribution and retailing of perishable goods under certain low temperature environment. It is a part of cool logistics and transport technology. Because of the complicated environment and long transport duration, the refrigerated transportation is the key to keep the quality in the whole cold chain.

The world population is growing. It has increased from 5.3 billion in 1990 to 6.4 billion in 2000. It is predicted to be 11.2 billion by the year of 2010. In order to meet the food demands, an efficient refrigerated transportation is necessary. According to the statistics, there are at least 1 million refrigerated trucks and 400,000 refrigerated containers in use in the world. The retail value of the products transported can be estimated more than 1200 billion US dollars.

In China, fresh and live produces and other perishable goods need refrigerated transportation urgently. According to interrelated statistics, there are more than 7000 refrigerated railway cars, 30,000 refrigerated trucks, 100,000 tonnes water refrigerated

vessels and 10000 refrigerated containers in use. However, the number is still deficient. Today, more than 120 million tonnes perishable goods need refrigerated transportation, but only half of them have been transported because of the restrict of condition and ability of refrigerated transport. More than 15% of foodstuff transported has decayed in the course of transport.

Low temperature is the key to keep the quality of perishable goods, but it is not the only necessary and sufficient condition. The excellent transport quality of perishable goods depends on the suitable control of temperature and humidity and the integrated use of multi-exercise. For example, Excessive low temperature would cause food frostbite and nutrition loss, on the other hand, excessive high temperature would result in rot. Excessive low humidity would cause serious weight-loss of food. On the other hand, excessive high humidity would result in mouldy. Moreover, temperature and humidity are only two main factors affecting quality of food transport.

This research aims to find the best control technology and method, which would keep the quality and reduce the weight-loss of perishable goods, and guarantee the edible safety of food, based on the character of perishable goods transportation.

In order to achieve the object, we will conduct a study to simulate the factors and find the principle of food. In the first, by means of refrigerated transportation experiment platform, we will test the best reference point under actual transport conditions by adjusting and controlling temperature, humidity, airflow and air composition, etc. In the second, we will set up heat and mass transfer models by computed simulation based on experiment data. The optimal control method would provide guidance for refrigerated transportation of perishable goods.

4. Achievements of IRG in 2009-2010

4.1 Paper, report and book:

- ***Degree thesis:***

1) Zou Yifeng. Study on the safety reliability of food cold chain logistic [Doctor Thesis]. Tutor: Xie Ruhe. Changsha: Central South University. 2009.11

- ***Paper:***

1) Liu Guanghai, Xie Ruhe. Simulation and experimentation on the heat status of refrigerated car. Journal of Wuhan University of Technology (Transportation Science & Engineering). 2009.8
2) Zou Yifeng, Lin Chaopeng, Fu Wei. Temperature and quality change of pasteurized milk during refrigerated distribution. Science and Technology of Food Industry. 2009.4
3) Liu Guanghai, Xie Ruhe. Study on standard system of food cold chain. Storage Transportation & Preservation of Commodities. 2009.7
4) Liu Guanghai, Xie Ruhe. Study on the status and current of refrigerated transportation unit. Guangxi Journal of Light Industry. 2009.8
5) Huang Xiangrong, Xie Ruhe. The emergent deliver decision model based on ant colony optimization algorithm and RBF neural network. Stat. and decision. 2009.8
6) Lin Chaopeng, Xie Ruhe. Study on the quality changes of fresh pork under the logistics modes. Logistics Engineering and Management. 2009.3
7) Xiao Wenzhong, Qiu Zhuqiang, Xie Ruhe. Evaluation of the Safety of Sale Logistics of Regional Fresh Agricultural Products. Industrial Engineering Journal.2009.1
8) Liu Guanghai, Xie Ruhe. The investigation of energy consumption of refrigerated

transportation based on season and class. Guangxi Journal of Light Industry. 2009.7
9) Huang Xin, Xie Ruhe. Liu Guanghai. Analysis on Temperature Field of Refrigerated Car in Cold Chain Logistics. Zhangjiajie: 2009 International Symposium on Traffic Control and Safe. 2009.4
10) Liu Guanghai, Xie Ruhe, Qu Ruigui. Simulation and experimentation on quality and energy consumption in banana transportation. Manchester: Proceedings of Second International Conference on Modelling and Simulation. 2009.5
11) Liu Guanghai, Xie Ruhe, Qu Ruigui. Study on the consumption forecast model of perishable food distribution. Manchester: Proceedings of Second International Conference on Modelling and Simulation. 2009.5
12) Huang Xin, Xie Ruhe. The Simulation and analysis on integrated temperature used in energy consumption of refrigerated transport. Manchester: Proceedings of Second International Conference on Modelling and Simulation. 2009.5
13) Lin Chaopeng, Xie Ruhe. The quality changes and safety risks evaluation of fresh pork under the logistics modes. Tianjing: The 20th National Conference of Refrigeration, 2009.11
14) Xie Ruhe, Liu Guanghai, Huang Chengzhou. Refrigerating system simulation and experiment of temperature-controlled transportation. Tianjing: The 20th National Conference of Refrigeration, 2009.11
15) Liu Guanghai, Xie Ruhe. The analysis on infiltrated model of refrigerated transportation unit. Tianjing: The 20th National Conference of Refrigeration, 2009.11
16) Xie Ruhe, Liu Guanghai, Fu Wei. Study and simulation to the impact of temperature feld by air supply inside refrigerated container. Tianjing: The 20th National Conference of Refrigeration, 2009.11
17) Alan Foster, Laurence Ketteringham, Andrew Gigiel, Judith Evans. Development of an empirical model of air infiltration into refrigerated multi-drop delivery vehicles. Tianjing: The 20th National Conference of Refrigeration, 2009.11
18) Liu Guanghai, Xie Ruhe, Chen Baoxing. Study on quality test method of banana during transportation. Surabaya: Proceedings of the Eastern Asia Society for Transportation Studies. 2009.11
19) Xie Ruhe, Zou Yifeng, Lin Chaopeng, Wang Lei. Temperature and quality changes of pasteurized milk during refrigerated distribution. Surabaya: Proceedings of the Eastern Asia Society for Transportation Studies. 2009.11
20) Huang Xiangrong, Xie Ruhe, Chen Baoxing. Performance evaluation of food cold chain logistics enterprise and its application to supplier selection decision. Surabaya: Proceedings of the Eastern Asia Society for Transportation Studies. 2009.11
21) Xie Ruhe, Lin Chaopeng. Quality changes of fresh pork during logistics. Surabaya: Proceedings of the Eastern Asia Society for Transportation Studies. 2009.11
22) Hammond, E, Evans, JA & Foster, AM. Development of a design tool for recirculated air curtains used on retail display cabinets. Proc. of 1st IIR International Conference on the Cold Chain and Sustainability. Cambridge. UK – 29-31 March 2010.
23) Foster, AM, Brown, T, Gigiel, A. & Evans, JA. Air cycle combined heating and cooling for the food industry. Proc. of 1st IIR International Conference on the Cold Chain and Sustainability. Cambridge. UK – 29-31 March 2010.
24) Foster, AM. Introduction to Mathematical modelling - CFD in

Refrigeration. Workshop presentation. Proc. of 1st IIR International Conference on the Cold Chain and Sustainability. Cambridge. UK – 29-31 March 2010.

4.2 Seminar, symposium and special session: (Title, Date, Venue & abstract)

2009.1	The National Symposium of Cold Chain Education	Guangzhou
2009.4	2009 International Symposium on Traffic Control and Safe	Zhangjiajie
2009.5	Proceedings of Second International Conference on Modelling and Simulation	Manchester
2009.10	The Symposium of Cold Chain Between China and USA	Guangzhou
2009.11	The 20th National Conference of Refrigeration	Tianjing
2009.11	Proceedings of the Eastern Asia Society for Transportation Studies	Surabaya
2010.3	Proc. of 1st IIR International Conference on the Cold Chain and Sustainability	Cambridge
2010.4	The Symposium of Cold Chain in South China	Guangzhou
2010.8	The National Symposium of Logistics Education	Changsha

4.3 Group meeting: (Date, Venue & abstract)

Date	Proceeding	Remark
2009.1	Group meeting	Plan and summary
2009.7	Group meeting	Plan and summary
2009.10	Group meeting（For 1 mouth）	The International Cooperative Research Activity summary
2009.11	Group meeting	The International Cooperative Research Activity summary
2010.1	Group meeting	Experimentation plan and summary
2010.4	Group meeting	udy on the simulating test-bed of refrigerated transportation condition
2010.7	Group meeting	Experimentation plan and summary

4.4 Result of application for the research grants: (Name & result)

1) Some research production has been used in national standard “GB/T 22918-2008. Technical requirements for temperature-controlled transportation of perishable food”.
2) The paper “Heat balance models for refrigerator car and simulation on the temperature field” got the third grade award of excellent paper in China Refrigerated Academy in 2009.
3) The paper “Study on safety reliability of cold chain system” got the second grade award of excellent paper in China Refrigerated Academy in 2009.

4.5 Promotional activities of your IRG: (Home page, Newsletter, Mailing list etc.)

Our work will be shown in www.gd56.org

The E-mail address: rhxie@gzhu.edu.cn

Will you continue your IRG’s activity after August 2010?

[YES] → We want to change the name of IRG to “Research on the energy

consumption control in refrigerated transportation based on food security”

5. Future research plan and including time frame with the following items:

- Possibility to hold seminar and symposium in 2010. (Date & Venue)

1) The 9th National Conference of Logistics, 2010, China
2) The National Conference of Refrigerated Transportation, 2010, China
3) The 3rd International Conference on Modelling and Simulation, 2010, China
4) The First International Conference of Cold Chain, 2010, England
5) The 23th International Congress of Refrigeration, 2011, Czech
6) The 2011 EASTS conference, 2011, Korea

- Special considerations to young researchers

Refrigerated transportation is a domain involving multi-subject and adopting various techniques, including logistics, transportation engineering, economic and management, mechanism manufacture, the technology of refrigeration, the technology of food processing, etc. Our research is comprehensive. It takes the leader in this research field.

On the other hand, submitted 2~3 papers to 2011 EASTS conference, 2~3 doctors and 2~3 masters will be brought up by the project.