PAPER ID: XXX [Paper ID]

DOI: 10.18462/iir.iccc.2018.0048 [DOI Number]

CaRe: IIR Working Group with emphasis on Women in Refrigeration

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ABSTRACT

The refrigeration industry plays a major and increasing role in today’s global economy, with significant contributions made in food, health, energy and environmental domains which policy makers need to better understand and take into account. The need for engineering and technical staff is currently increasing due to the growing demand for refrigerating capacities, along with the unique skills required from refrigeration-related professions in the field of energy and environment. There is a need to attract the young generation into the industry especially minority groups such as women. This is one of the main priorities of the International Institute of Refrigeration. Women are still significantly and visibly under-represented in the refrigeration industry. The purpose of this paper is to demonstrate the current preliminary state-of-the-art of women in the refrigeration field collected from national refrigeration institutions and associations. Suggested incentive actions are the outcomes of meetings carried out by the IIR Career in Refrigeration (CaRe) working group.

Keywords: Women, Refrigeration, Engineering.

1. INTRODUCTION

The International Institute of Refrigeration (IIR) estimates that the total number of refrigeration, air-conditioning and heat pump systems in operation worldwide is roughly 3 billion (IIR, 2015). Global annual sales of such equipment amount to roughly 300 billion USD and the refrigeration sector consumes about 17% of the overall electricity used worldwide. Statistical data presented in the IIR Informatory Note (2015) highlights the importance of the refrigeration sector, which is expected to grow further in the coming years because of increasing cooling needs in numerous fields and global warming. The refrigeration industry plays a major and increasing role in today’s global economy, with significant contributions made in food, health, energy and environmental domains, which policy makers need to better take into account.

The IIR (2015) estimates that almost 12 million people are employed worldwide in the refrigeration sector, which means that almost 4 workers out of 1000 have a job linked to the manufacturing, installation, maintenance and servicing of refrigeration equipment. This ratio is even higher in countries, such as Australia, where around 173,000 people (1.5% of the workforce) are employed in over 20,000 businesses operating in the refrigeration sector (AGDE, 2015). In the US, employment of mechanics and installers in heating, refrigeration and air conditioning is expected to grow by 21% from 2012 to 2022, much faster than the average for all occupations (11%) (US Department of Labor, 2014). In this field, the need for engineering and technical staff (e.g. installers and mechanics) increases due to the growing demand for refrigerating capacities, along with the unique skills required from refrigeration-related professions in the field of energy and construction. Women are still significantly and visibly under-represented in the refrigeration industry. For instance, women represent 10% of the IIR commission members (41 women versus 369 men) and less than 10% of participants of the IIR Congress held in August 2015 in Yokohama, Japan, were female (IIR, 2015). Global Cold Chain Alliance (2015) stated that women represent only approximately 12% of their members. The purpose of this paper is to demonstrate the current state-of-the-art of women representation in the refrigeration field and the data was obtained from the national refrigeration institutions and associations. Suggested incentive actions are the outcomes of the second meeting of the official IIR Women in Refrigeration sub-group that took place at the 12th IIR Gustav Lorentzen Conference on Natural Refrigerants (GL2016) in Edinburgh (UK).

1. Women in Science and Engineering

Governments and industry across the industrialized countries support efforts to improve the representation of women professionals in the field of science and engineering by recognizing the scale of the untapped pool of qualified women in this area. Although these efforts have had a positive impact, engineering remains a largely male-dominated profession in most countries.

A United Nations Educational, Scientific and Cultural Organization (UNESCO) report on Women in Science (UNESCO, 2012) shows national breakdowns of female researchers in science worldwide. At regional levels, this report stated the averages of 45.2% for Latin America and the Caribbean; 34.0% for Europe; 34.5% for Africa; 18.9% for Asia; 39.2% for Oceania; and unfortunately, there is no regional average available for North America due to a lack of data. These figures include women working in life sciences, which involve the scientific study of living organisms (such as microorganisms, plants, animals, and human beings). Women are highly represented in life sciences (NSF, 1996).

Table 1: Percentage of women in Engineering per Country (Colombo *et al.,* 2016)



Despite the shortage of engineers stated by UNESCO (2010), records show that women were significantly under-represented in the fields of engineering, constituting an average of 10-20% of engineering workers (IGU/UNESCO, 2013). Table 1 summarizes published data related to the percentage of women in engineering per country. According to the IGU/UNESCO report (2013), in the US and Europe, women now constitute 30% of university engineering students, and that number rises to 35% in India, 15% in South Africa, and up to 60% in the Gulf countries (including Kuwait). However, even in countries where the number of women studying in STEM (science, technology, engineering and mathematics) has increased, this trend has not necessarily translated into increased employment of women engineers. Indeed, a large number of graduate students do not enter the engineering profession, which is due to several factors such as cultural and religious backgrounds.

1. Women in Refrigeration

There are no official records of the number and/or percentage of women in the refrigeration industry and few incentives have been put in place to encourage women to consider a career in the industry. Established in 2004, Women in HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) (2015) is based in the USA with the objectives to improve the lives of members by providing professional avenues to connect with other women growing their careers in the HVACR industry. Women in HVACR empower women to succeed through networking opportunities, mentoring and education. The Cryogenic Society of America (2015) had a cover story on women in cryogenics and superconductivity where several women who are excelling in this field discussed their experiences. A report from the US Department of Labor (2014) stated that women represent 1.2% of the heating, air conditioning, and refrigeration mechanics and installers for non-traditional (male-dominated) detailed occupations. According to the North American Industry Classification System (2011) in Canada, the percentage of women represents about 1.7% of the refrigeration and air conditioning mechanics (includes office staff, etc.) of the maintenance and equipment operation trades. Women in ACR series of the UK ACR Journal (2015) interviewed several women working in the HVACR industry on their career path, development and prospective.

At the latest IIR International Congress of Refrigeration (ICR2015) in Japan, the IIR organized the first Women in Refrigeration network session (IIR, 2015) where the twenty attendees (75% female, 25% male) were present to discuss some key aspects of women in refrigeration drawing both on their own experiences and those of others to reflect on what helped and hindered women from joining the profession. A preliminary state-of-the-art of women in refrigeration industry was presented (Colombo *et al*., 2016).

* 1. Survey

Obtaining some records of the number or/and the percentage of women working in the refrigeration industry excluding office and support staff was a difficult task according to the different national refrigeration associations/organizations approached. Therefore, it was decided that the number or/and the percentage of women registered as private members of national associations could be appropriate figures of women representation in the industry. In total 25 worldwide national refrigeration associations have been contacted for this purpose.

* 1. Results

Eighteen of the listed associations replied to the IIR request for the percentage of female members registered as private members in the year 2014-2015 and results are shown in Table 2. Women registered under corporate memberships were excluded as they could be office and/or support staff with no knowledge and practice of refrigeration. Some associations were kindly requested to provide additional figures on the evolution of their women memberships over the previous decade. Some associations were unable to provide information.

The IIR Brazilian correspondent provided figures from the Brazilian Society for Contamination Control, which was not related to the HVAC industry. Canada quoted the figures from the North American Industry Classification System (2011). Additional information included by the IIR Chinese correspondent who stated that women have played a very important role in the Chinese HVAC&R industry and for the last 10 years the female membership had remained stable. The Japanese contact stated that the female membership had significantly increased by 68% from 2005 to 2015. The Jordanian correspondent replied that Jordan does not have any national refrigeration association and that the JNC is part of the mechanical engineering branch of the University of Jordan (UJ). However, they stated that the numbers of women students in the UJ who take classes in refrigeration is around 8% of the total students attending these courses and the same percentage of women join design activities in areas of refrigeration and air conditioning practices. The Russian contact tried unsuccessfully to obtain national figures from the Russian Government and therefore provided an estimation of 3%, highlighting that after studies a certain percentage of married women probably leave the profession, but in general they try to work in the refrigeration industry. The South African president of the refrigeration association also added that women membership has increased by 35% since 2005. The Swiss correspondent replied that statistics about the gender of the employees of their company members was unavailable and that all their company members were male. It should also be noted that the Swiss association also has individual memberships. ASHRAE provided figures of 3.92% for 2008, 3.20% for 2011 and 4.33% in 2015 demonstrating an increase of 10% in female memberships over this period.

The Romanian figures are quite high compared to the other associations and include women managers, professors, experts, technicians and assistants. The Romanian correspondent added that at the time of Ceausescu (president up until 1989), women in engineering represented more than 30% of the refrigeration industry. For instance in 1983 in the Building System Faculty of the Technical University of Civil Engineering of Bucharest, that about 50% of women graduated as building services (BS) diplomat engineers and of the total women who graduated as BS diplomat engineers, 30% were involved in refrigeration and air conditioning.

Table 2: Percentage of Women Memberships (Colombo *et al.,* 2016)

|  |  |
| --- | --- |
| **Country** | **Percentage of women members** |
| Australia | 3.1 |
| Brazil | 6.3 (Not reliable) |
| Canada | 1.7 |
| China | 19.5 |
| Congo | 0.1 |
| France | 7.0 |
| Germany | 5.3 |
| Italy | 8.8  |
| Japan | 2.3 |
| Jordan  | 8.0 (Not reliable) |
| New-Zealand | 1.0 |
| Norway | 2.2 |
| Russia | 3.0 (Not reliable) |
| Switzerland | 0.0 |
| USA | 4.3 |
| United Kingdom | 2.0 |
| Romania | 33.0 |
| South Africa | 2.8 |

The gap between women in Science and women in Engineering/Refrigeration is significant and highlights the fact that women are less attracted by engineering and technical careers. It is noticed that communist and ex-communist countries such as Romania, Estonia, China and Russia are more likely to have high number of women working in STEM subjects.

1. IIR “Career in Refrigeration” Working Group

The need to attract the young generation into the refrigeration industry is the priority of the International Institute of Refrigeration. An IIR “Career in Refrigeration” (CaRe) working group was officially launched in 2016 and approved by the IIR Science and Technology Council (STC) (IIR Working Group, 2016). Also, a “Woman in Refrigeration” IIR sub-working group has been created as part of CaRe in order to target women.

A first IIR Women in Refrigeration Workshop was organised during the 24th International Congress of Refrigeration, ICR2015 in Yokohama (Japan). A CaRe second meeting took place at the 12th IIR Gustav Lorentzen Conference on Natural Refrigerants (GL2016) in Edinburgh (UK).

* 1. Outcomes of the meeting discussions

The overall discussion topic for the two meetings related to specific actions that could potentially attract young people into the industry and increase both the cultural diversity and numbers of women in refrigeration. The discussions highlighted some key areas. These are outlined below along with some specific quotes from the attendees. The main issues around attracting more young people into refrigeration are as follows:

* Lack of specific degrees in refrigeration: Refrigeration crosses over with other engineering degrees, which have higher profiles. “I discovered refrigeration during my chemical engineering degree”; “In Australia people fall into refrigeration”.
* Recognising the need for young people at all levels: The refrigeration industry needs multifaceted, ‘jack of all trades’ people, to undertake the varied work. “We need technicians too and that is a different educational route”.
* Remuneration and status of refrigeration: “Refrigeration is hidden/invisible in the UK”
* Are there specific barriers for women?: Consider using different language “‘Mechanical’ can be off-putting for some women but they are attracted to ‘energy’ and ‘environmental”; Design, as well as site work is available and this is important for some women to know, who may prefer not to go on site. “We need women not just as engineers but also in design, finance and marketing”; “The challenge is we need to show they are needed”.
* What problem are we trying to solve?: Recruitment into engineering or into refrigeration? “Maybe both? In the UK alone 1.2m new people in engineering of all types are currently needed.
* Research needed: PhD in Women in Engineering; Family connections “In Germany – a high % of women engineers have engineer fathers”; “Promotional ideas should be proposed”.
* Make increasing use of social media: Video stories of ‘how I got into refrigeration’ – put on YouTube (ref. engineer’s dance); Facebook stories about real people “The humans of HVAC & R”; Twitter – use #GL2016 and similar to send out positive messages for young people and women. #CARE is already set up; Linked-in groups (some of these already exist, they need to be cross-linked).
* Use stories about helping people/solving problems: Start in early school (this was successfully used in US where women engineers are close to 30%). “In Hanover the Montreal Protocol was a driver for recruitment – ‘save the world’ appeal”.
* National/educational campaigns/ideas: e.g. UK Women in Engineering. Need to share what all countries are doing and what is working/not working. Early years work experience/ open weeks for women in the purpose to influence the influencers – parents, teachers, career advisers to recommend STEM careers and the industry sponsored talks such “Cool science” and the planned 2018 exposition on Refrigeration at the Cité des sciences (La Villette, Paris). Could this more widely/be replicated elsewhere?
1. Conclusion

This paper describes the outcomes of dedicated group discussions that took place at the first and second IIR Woman in Refrigeration meetings. The IIR Woman in Refrigeration sub-working group is leading the IIR CaRe working group as the incentives to attract young women are more or less the same as those needed for all young people. The preliminary evaluation demonstrated that 6.13% (average of Table 2) of women are members of national refrigeration associations/organizations/institutions. This figure could potentially be extrapolated to represent women in the whole refrigeration industry. However, it is important to highlight that there has been a significant increase in women membership in some countries such as South Africa and Japan, which should be encouraged and duplicated in other countries.

Progress on the initial objectives set in the first IIR workshop (Colombo *et al.,* 2016) is ensured by focusing on the different social, environmental and economic aspects, in particular by:

* Continuing to have progress meetings during IIR conferences. The third Women is Refrigeration meeting will take place at the occasion of the IIR International Congress of Refrigeration in 2019 (ICR2019) in Montréal Canada in August 2019.
* Having more women represented on each IIR working group and commission. In 2016, Prof Judith Evans and Dr Catarina Marques have been respectively appointed as the new president of the IIR Commission C2 on food science and the chairman of the “Career in Refrigeration” IIR working group.
* Increase visibility by promoting refrigeration to the younger generation. The IIR is part of the Management Committee of the Exposition on Refrigeration at the La cité des sciences et de l'industrie (in Paris, France) planned in 2018 which has the main objective to promote refrigeration to kids from primary, secondary and high schools. The IIR will organise a speed-networking event for students and young researchers during the next ICCC2018 and ICR2019.

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