MARKET RESEARCH REGARDING PROBLEMS IN USING POLYETHYLENE PIPE AND FITTINGS

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ABSTRACT: Pipe and pipe fittings of organic polymeric material such as polyethylene have become widely known and used for diverse purposes such as for conveying fluids. Piping systems of polyethylene material have been found to be desirable especially in view of the ease with which such systems may be fabricated. The paper is a market study that aims to identify the problems encountered in welding polyethylene pipe - fittings assemblies. The market study is made within companies that activate in the field, gathering answers from polyethylene certified welders, technicians responsible with welding techniques, and from those who supervise and manage these activities.
KEY WORDS: polyethylene pipes, fittings, electrofusion welding, market research.

1 INTRODUCTION

Thermoplastics are increasingly used in applications where significant loads are applied for extended periods of time. Plastics pipes, in particular pipes made of polyethylene, are widely known for use in forming pipelines for conveying fluids such as water or natural gas. Such pipelines are made by joining together a succession of individual pipes using pipe fittings (Pfeiffer, 2002).

Shaped structures including pipe and pipe fittings of organic polymeric material such as polyethylene have become widely known and used for diverse purposes such as for conveying fluids. Piping systems of polyethylene material have been found to be desirable especially in view of the ease with which such systems may be fabricated. For example, pipe fittings and pipe may be easily assembled together by utilizing chemical solvents, adhesives or heating treatments for joining these pieces, e.g., polyethylene pipe fittings may be joined to polyethylene pipe by heating the fitting and the pipe before assembly to melt the polyethylene at the region or surface of each piece to be contacted followed by mating the heated surfaces of each piece and cooling the heated pieces whereby to effect fusing of the polyethylene to provide a structure of unitary construction (Thompson, 1977).

Information is a primary resource for making science-based management of the marketing activity, for integrating it into the system of other activities of the enterprise and for ensuring a higher degree of adaptability to conditions in which they operate, in order to meet to a higher extent the market requirements.

Marketing is a whole system of economic activities related to research and development (design) of products, their pricing, promotion and distribution that are designed to satisfy current or potential consumers for achieving the organization's objectives or in short: it is the human activity directed towards satisfying human needs and wants through an exchange processes.

The marketing concept argues that the key to achieving an organization's own objectives is to determine the needs and wants of targeted consumers and delivering the expected satisfaction more effective and quicker than the competition. The marketing concept aims to "satisfy the customer's needs in terms of profitability'. This concept is more recent and may be limited to "find needs and meet them" (Duse et al, 2003).

This paper presents a marketing research regarding the problems in using polyethylene pipes and fittings, carried among users, producers and distributors of such pipes and fittings.

2 POLYETHYLENE PIPE AND FITTINGS

Metal piping is preferred in high pressure systems. The problem with metal piping is that it is prone to rust or corrode. Therefore today high pressure systems are increasingly being made out of plastic. The plastic pipes are do not corrode and the reduced weight of the plastic piping facilitates installation. However connections between plastic pipes, especially where they are attached to metal piping as proven problematic. Failures often occur at threaded connections between metal and plastic

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pieces. One reason for this is that threaded plastic cannot take high torques or stresses. Plastic adapter threads are prone to attack by solvent adhesives used to secure plastic and metal parts together. During installation cracks in plastic couplings often occur from overtightening (McPherson et al, 1994).

It is well known that polyethylene (PE) is used for pressurized water pipes. PP water pipe has a variety of advantages, such as high performance-to-cost, light weight, thermal stability, chemical resistance, easy installation, as well as long-term service time (Boyd, 1985), (Krishnaswamy, 2007).

Plastics have steadily replaced clay, copper, asbestoscement, aluminum, iron, and concrete pipes in various applications. Among the plastics employed in pipes, PVC accounts for about 75% while polyethylene is employed in about 20% of the plastic pipe applications. Polyethylene (PE) pipes are used extensively for the transportation and distribution of natural gas, accounting for about 80% of the new piping installations (Mruk, 1988).

3 OVERVIEW OF MARKETING RESEARCH

Marketing needs to know and anticipate the changes that occur in the environment of the enterprise, especially in the "market". The management of the company must deal differently the coordination and integration of all activities in terms of meeting current and future requirements of consumers and users.

Marketing research is not limited to the market sphere, but also pursues:

- The influence of other environmental components of the market activity of the unit (general evolution of the economy, the economic sector concerned, the development of competition and its marketing policy, legislative and institutional framework, technological environment etc .:
- The investigation of consumer needs (size, hierarchy, relationships, ways of materializing through consumption demand in the market);
- The study of the purchasing and consumption behaviours of buyers (consumers and users rights, consumption and its features, purchase decision process, determinants of consumer purchasing behavior and conducts purchase and consumption);
- Investigations designed to direct the marketing-mix (for each component: production, price, placement, promotion)

Due to the complexity of processes and phenomena there occurred more classifications, the main criterion being the goal of the research. Based on these goals, the investigations are: exploratory, instrumental, descriptive, explanatory (causal) and predicative.

A marketing research requires a number of activities:

a- Problem identification and definition of the scope of the research – it is an important stage in a research process, it having a decisive role.

b- Evaluation of the objectives and assumptions – it relates to the first stage, having an impact on the research methodology and its costs. Thus, by formulating objectives it is stated what information is needed for each side of the matter investigated.

c- Preliminary estimates of the value of information to be obtained through research - allows sizing marketing research budget. The information obtained from the marketing research is used for decision making in the management of the problem.

d- Choices of sources of information - is the phase where decisions are made regarding the type, source, nature and form of information to be collected. The information can be used to research the causal relationships between the investigated variables and information can also be used to study the association relationships between variables.

e- Selecting the method of collection and systematization of information - concerns some aspects such as the definition of studied variables, their classification (dependent and independent) variables determining how to measure (with or without the metric scale), their methods of collecting and systematizing information gathered (investigation of statistical sources, direct research, experiments and simulation of phenomena) completion tools for collecting information and research program.

f- Harvesting information - relates to the organizational aspect and the methods used in this step.

g- Processing - aims at bringing the information in such a form that one can proceed to the analysis and interpretation.

h- Analysis and interpretation of information - is a complex process, using more quantitative and qualitative methods. Finally, it seeks to find an answer with a scientific foundation for each hypothesis advanced in early research.

i- Writing and drawing conclusions of the study - represents the last stage of marketing research.

Data collection method: tracking (supervision), observation and experimentation. Normally all the three methods are not used simultaneously in a single project. The choice of method is based on the time available, the Fund, staff, facilities etc.

4 MARKET STUDY ON THE USE OF POLYETHYLENE AND PROBLEMS ENCOUNTERED IN WELDING

After the euphoria of "cosmetic arrangement" evidenced by the changing of names of firms, by the changing of names of departments, by establishing or abolishing departments, the decision makers of the new companies began to realize that competition laws are tough and objective, so the only way to survive is to know and to apply them properly.

This research, conducted in collaboration with the National Regulatory Authority for Energy (NRAE), Eon Gaz Romania, Fusion Romania and PROCONFORT covers the following objectives:

- collecting information regarding the structure and volume of activities of the current beneficiaries of polyethylene fittings and pipes;
- Identifying current requirements, grievances and future needs of current beneficiaries to improve the activities of business firms and to forecast future orientation in their production;
- Identification of new beneficiaries;
- Testing the reaction of industrial consumers to such actions, that are usual in a structured market economy.

The research was carried out on a questionnaire basis, which were completed by a total of 164 people, representing engineers, project managers that oversee the gas works, certified welders, NRAE certified engineers, technicians responsible with welding techniques, etc.

There were signed contracts with NRAE, Eon Gaz Romania, Fusion Romania and PROCONFORT in order to support the proposed activities.

The companies that participated in this study were from the following areas (see figure 1):

- Legislation regarding the use of pipes and fittings in natural gas - the National Regulatory Authority for Energy (NRAE) - 8;
- Largest network developer in the country - Eon Gaz Romania - 85;
- Manufacturers and distributors of materials: Fusion Romania, Romstal Valrom CIA Trade, Sibtub - 27;
- Developers and network maintenance: PROCONFORT, Eurowagen, Sinecon, Instal Grup, ConsPro, Standard Plumbing - 44.

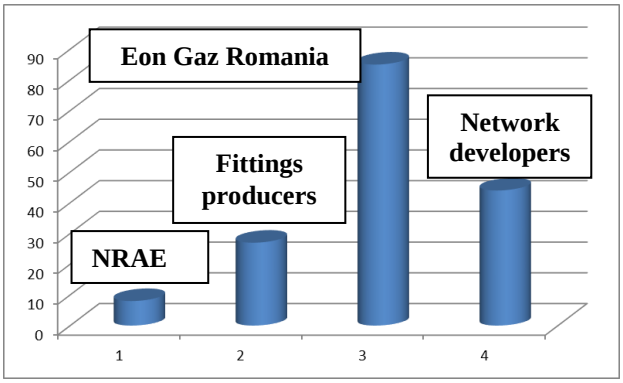

Figure 1. Distribution of persons participating in the questionnaire

5 RESULTS

The questionnaires were analyzed using MS Excel and SPSS and the results are presented as follows.

The respondents use the polyethylene pipes and fittings mostly for developing new gas distribution networks, followed by the distribution of spare parts and repairs of the gas network, as shown in figure 2.

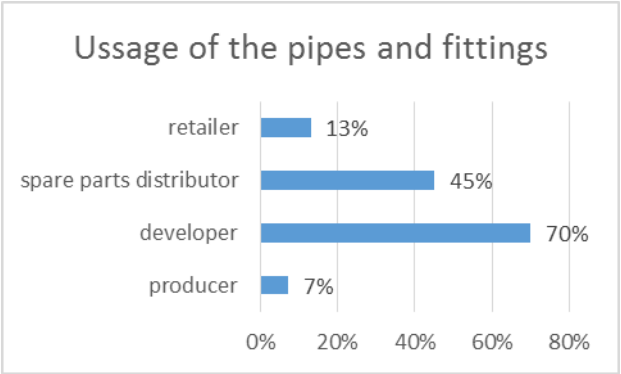

Figure 2. The profile of the respondents

The preferred type of welding for polyethylene pipes and fittings is electrofusion welding. 35% of the respondents declare that they use exclusively this procedure and another 41% say that 75% of the welding that they do is made through electrofusion. This shows that the respondents are using modern techniques and this information is completed by the next question, regarding the age of the equipment that they use. Over 65% of the equipment of the respondents is between 2 and 5 years old and very few of the respondents say that their tools and equipment are older than 6 years.

Figure 3 shows that the origin of the welding equipment is mostly foreign. More than 81% of the respondents declare that they use mostly foreign tools while only 9% use Romanian equipment.

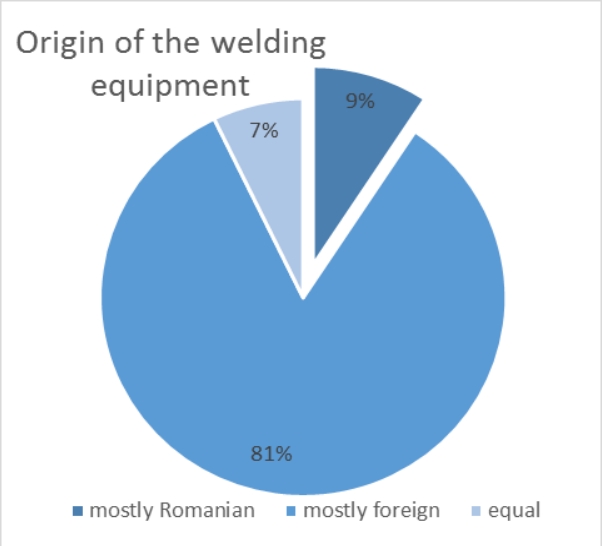

Figure 3. Type of welding equipment used

The research showed the percentage of polyethylene pipes and fittings provided by the main distributors in this field. Thus, 59% of the respondents said that more than half of their products are provided by Fusion Romania, followed by Techoworld with 12% and Palplast. This question reveals behaviors in the market that can be used by decision makers of companies that activate in the field of gas distribution networks.

One reason why Fusion Romania is the preferred producer might be the customer satisfaction. 56.67% of the respondents say that the quality of the products purchased from Fusion Romania is very good, 41.67% consider that the products are good, while only 1.67% say the quality is satisfactory. It is interesting to observe that there is no customer who is totally disappointed by the quality of the polyethylene pipes and fittings produced by this company (see figure 4)

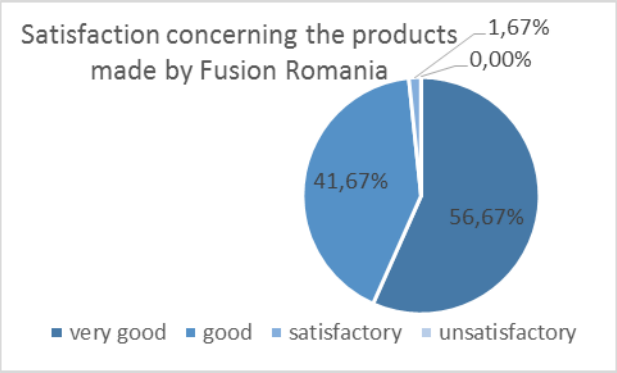

Figure 4. Customer satisfaction for the products offered by the market leader

Customer satisfaction is also on very high levels, concerning the services offered by this company. More than 93% of the customers consider that the services offered by Fusion Romania are good and very good, while only 1.72% think that the services offered are unsatisfactory (see figure 5).

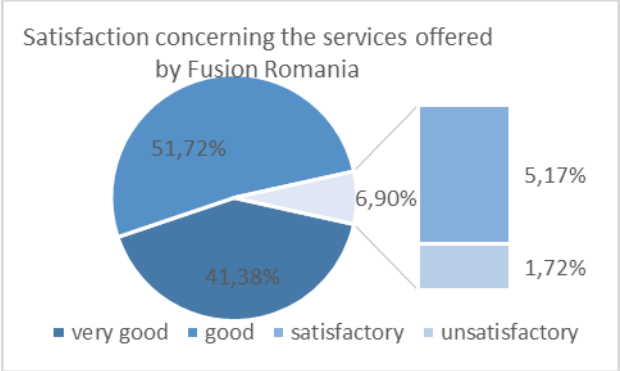

Figure 5. Customer satisfaction for the services offered by Fusion Romania

The market leader scores very high also in terms of the customer perception of the price for quality ratio. 91.38% think that the ratio is good or very good and only 8.62% consider this ratio to be satisfactory.

The respondents, who operate in the field of gas distribution network field are optimistic concerning their future activities. Figure 6 shows that more than 36% think that their business will grow in the near future and about 56% think that they will maintain the current amount of work.

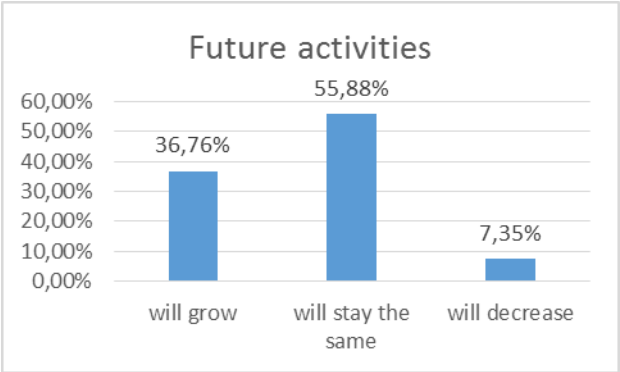

Figure 6. Estimation of future activities

The trends are similar when asked about the collaborations with other companies. The opinions change slightly when the respondents were asked about the usage of polyethylene pipes and fittings in the future. There isn't anyone to foresee a decrease of the usage of these materials, while 57.58% think that we will witness an increase of the usage of polyethylene pipes and fittings, as shown in figure 7.

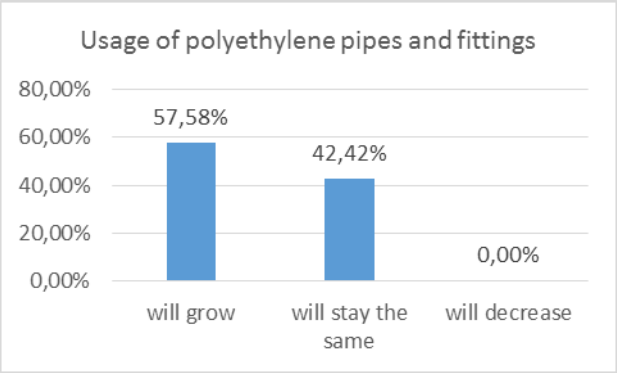

Figure 7. Perceptions regarding the usage of polyethylene pipes and fittings in the future

The last section of the questionnaire sought to identify which are the most common flaws and defects that occur in the usage of polyethylene pipes and fittings. As shown in figure 8, the most common defect is the ovality of the pipe, being signaled by more than 87% of the respondents.

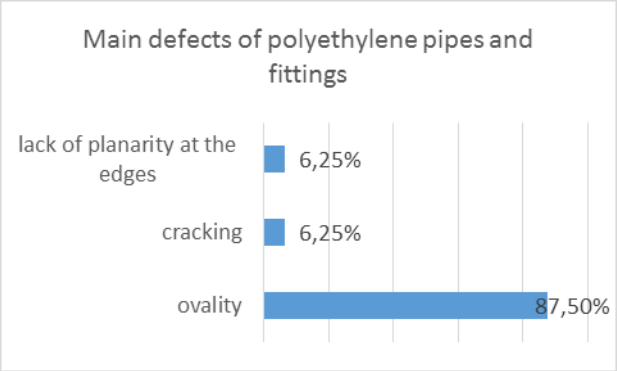

Figure 8. Main defects of polyethylene pipes and fittings

Other problems were identified in the welding process. The most common issue is ovality as well, being signaled by more than 56% of the respondents. Other 36% say that the most frequent issue that appears in the welding process is the inequality of the burrs, while 7.27% consider that the lack of planarity at the edges is the biggest problem that they face when welding (see figure 9).

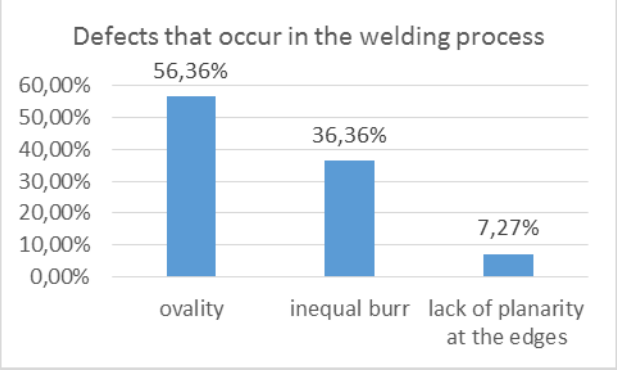

Figure 9. Defects that occur in the welding process

The errors that appear in the electrofusion welding of polyethylene pipes using clutches were investigated with an open question. Thus the specialists could writhe their experiences without being constrained by some given options. The most common issue that has been signaled by the respondents is the interrupted spiral. Other problems were incomplete welding, material leaks or unequal melting, depending on the density of the material.

The issues encountered in the welding of electrofusion knuckles (see figure 10) were similar to the ones mentioned above, but some problems regarding coaxiality, collinearity or tension variations were also mentioned.

Figure 10. Knuckle

The questionnaire also identified the most common problems encountered in the welding process of the T-squares and in addition to the ones already presented the specialists identified issues with the bar codes, interruptions of the metal insertion during the welding process and leaks due to incomplete welding.

6 CONCLUSION

Polyethylene pipe systems have a significant and growing market share for low pressure (<16 bar gauge) pipe systems, particularly for the transportation of fuel gas and potable water. For sizes at 8 inches (219 mm) and below, EF fittings are widely and successfully used for joining pipes and constructing pipe networks (Bowman, 1997).

Buyers require a good quality of the products and reasonable prices; they want a good brand, a rich variety of products, useful and pleasant things, honest sellers and a lot of services. Vendors ask lots of questions, such as: to what group of consumers should they turn their attention, which are the requirements of these customers and what products should be designed, what prices should these

products have in order to meet their desires, what kind of sale should they practice "wholesale" or "retail", which kind of advertisements should they promote or what type of sales personnel should they use and what salary should they be paid?

The main defects identified in the weld pipe assemblies - fitting are:

- nonlinearity of the assembly;
- incomplete Fusion; the welding witness didn't appear;
- the expulsion of molten material outward or inward;
- broken or shorted spirals;
- oval heads;
- failure to complete the welding cycle (device error);
- lack of sealing of the gasket of the branching T-square fitting for self-threading.

This research showed that the market of polyethylene pipes and fittings for gas networks in Romania is expecting a growing trend and pointed out the behaviors of the specialists who activate in this niche, highlighting also the most common problems that appear in electrofusion welding of pipes and fittings.

7 ACKNOWLEDGEMENTS

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8 REFERENCES

►Bowman, J. (1997). A review of the electrofusion joining process for polyethylene pipe systems. Polymer Engineering & Science, 37(4), 674-691.

►Boyd, R.H. (1985), Relaxation processes in crystalline polymers: experimental behavior – a review, Polymer, 26 (1985), pp. 323–347

►Duse, D. M. , Bondrea, I., Avrigean, E. (2003), Computer Integrated Manufacturing CIM of the transmissions shafts (Fabricatia integrata de calculator CIM a transmisiilor cardanice). Publishing house of Lucian Blaga University of Sibiu, 2003.

►Krishnaswamy, R.K. (2007) Influence of wall thickness on the creep rupture performance of polyethylene pipe, Polym Eng Sci, 47 (4) (2007), pp. 516–521

►McPherson, T. R., Spirkowyc, P. A., & Womeldorff, D. W. (1994). U.S. Patent No. 5,366,257. Washington, DC: U.S. Patent and Trademark Office.

►Mruk, S., (1988), ''Pipe,'' in Encyclopedia of Polymer Science andTechnology, 2nd ed., Wiley, New York, Vol. 11, 226.

►Pfeiffer, P. G. (2002). U.S. Patent No. 6,406,063. Washington, DC: U.S. Patent and Trademark Office.

►Thompson, D. M. A. (1977). U.S. Patent No. 4,023,831. Washington, DC: U.S. Patent and Trademark Office.

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