International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869, Volume-3, Issue-6, June 2015

Application of FMEA method for product quality improvement

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Abstract— **Purpose: A new approach to production process monitoring in organization using Failure Mode and Effect Analysis method has been presented.**

Design/methodology/approach: The possibility of use of Failure Mode and Effect Analysis methods is connected with continuous quality improvement of organization. Interdependence of the quality research methods and production process's requirements have been taken into account.

Findings: At the present time the enterprises should integrate quality management and quality control with customer's requirements, production process's requirements and also quality methods. Such kind of strategy will enable to achieve success for these companies.

Research limitations/implications: FMEA is a very important method which should be employed in companies for an engineering design, production process, new product in preproduction and production sphere in product life cycle. Aim of FMEA is establishing links between causes and effects of defects, as well as searching, solving and drawing the best decisions concerning application of proper action.

Practical implications: The example of implementing FMEA shows possibility of monitoring chosen production process according to idea of defects prevention. Usage of this method allows to keep a process production focus, reduction in the product development cycle, providing opportunities for cost reduction.

Originality/value: Application of Failure Mode and Effect Analysis in polish companies have been presented. It helps define Potential defect, Effects of defects, Defects causes in chosen production process of train hoops.

Index Terms— **Quality management; Failure Mode and Effect Analysis; The product life cycle.**

I. INTRODUCTION

Failure mode and effect analysis (**FMEA**) was one of the first systematic techniques for failure analysis. It was developed by reliability engineers in the 1950s to study problems that might arise from malfunctions of military systems. A FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded in a specific FMEA worksheet.

The FMEA is a design tool used to systematically analyse postulated component failures and identify the resultant effects on system operations. FMEAs can be performed at the system, subsystem, assembly, subassembly or part level. It should be scheduled and completed concurrently with the design. If completed in a timely manner, the FMECA can help guide design decisions. The usefulness of the FMECA as a design tool and in the decision making process is dependent on the effectiveness and timeliness with which design problems are identified.

The quality methods structuralize the enterprise and introduce the general responsibility for all individual action of his participants: managers, employers, suppliers, customers. The organization directed to the quality focuses on distinguishing parts of its operation based on responsibility for costs and profits. This organization tries to find the answer - how to control preproduction, production, after production sphere control with using all quality methods?

Quality management gives managers controlling tools concerning current activity and more important budgeting future economic in action being aimed.

THE QUALITY MANAGEMENT IN INDUSTRY

Quality management ensures that an organization, product or service is consistent. It has four main components:

1- Quality planning
2- Quality control
3- Quality assurance
4- Quality improvement

Quality management is a way to get better effects. Due to the great competition on world market amongst production companies there appeared a need for effective ways of improvement of the quality level of products. For many years different methods were tried to change the quality e.g. through economical instruments, however it turned out that there had been no significant relationship between the quality and the financial result.

The economic policy of the organization in the sphere of the quality depends on various outside factors and internal abilities. Such activity decides on choice about the optimum strategy.

According to ISO 9000:2005 standard - point *2.11 Quality management systems and other management system focuses* -"The quality management system is that part of the organization's management system that focuses on the achievement of results, in relation to the quality objectives, to

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satisfy the needs, expectations and requirements of interested parties, as appropriate. The quality objectives complement other objectives of the organization such as those related to growth, funding, profitability, the environment and occupational health and safety. The various parts of an organization's management system might be integrated, together with the quality management system, into a single management system using common elements. This can facilitate planning, allocation of resources, definition of complementary objectives and evaluation of the overall effectiveness of the organization. The organization's management system can be assessed against the organization's management system requirements. The management system can also be audited against the requirements of International Standards such as ISO 9001 and ISO 14001. These management system audits can be carried out separately or in combination".

Quality management is also implementing the management function in the relationship to the quality management system and the quality of processes. It is a philosophy replacing the lost time and human effort by engaging people into the process of management

Self-assessment "An organization's self-assessment is a comprehensive and systematic review of the organization's activities and results referenced against the quality management system or a model of excellence. Self-assessment can provide an overall view of the performance of the organization and the degree of maturity of the quality management system. It can also help to identify areas requiring improvement in the organization and to determine priorities"

Continual improvement "The aim of continual improvement of a quality management system is to increase the probability of enhancing the satisfaction of customers and other interested parties.

Results are reviewed, as necessary, to determine further opportunities for improvement. In this way, improvement is a continual activity. Feedback from customers and other interested parties, audits and review of the quality management system can also be used to identify opportunities for improvement"
Some other tools to improve and maintain the quality are;

- Statistical Process Control (SPC)
- Analysis of value,
- decision-making,
- calculation of quality costs,
- Seven Tools, Failure Mode and Effect Analysis (FMEA),
- Quality Function Deployment (QFD),
- Six Sigma,
- 5S,
- Kaizen,
- Taguchi Method,
- DOE,
- Brainstorming

FMEA-FAILURE MODE AND EFFECT ANALYSIS

FMEA is a method which enterprises use at preventing and eliminating defects which can appear in the manufacturing process. FMEA is the best analytical technique, because allow for establishing links between causes and effects of defects, as well as searching, solving and with drawing the best decisions concerning applying proper action.

This method was applied already in the 1950ies in the United States and in Japan, FMEA ensured the reliability of products of the high risk (e.g. aviation, astronautics). However in seventies this method found application in Europe in the electronics industry but then in the mechanical engineering. The fast growth of the competition in Europe as well as in the world and civil liability behind the produced product (CEE directive of No. 85/374) forced companies into increasing efforts in area of the quality preventions. It is a result was wide spreading FMEA methods in the eighties, above all in the motorization industry.

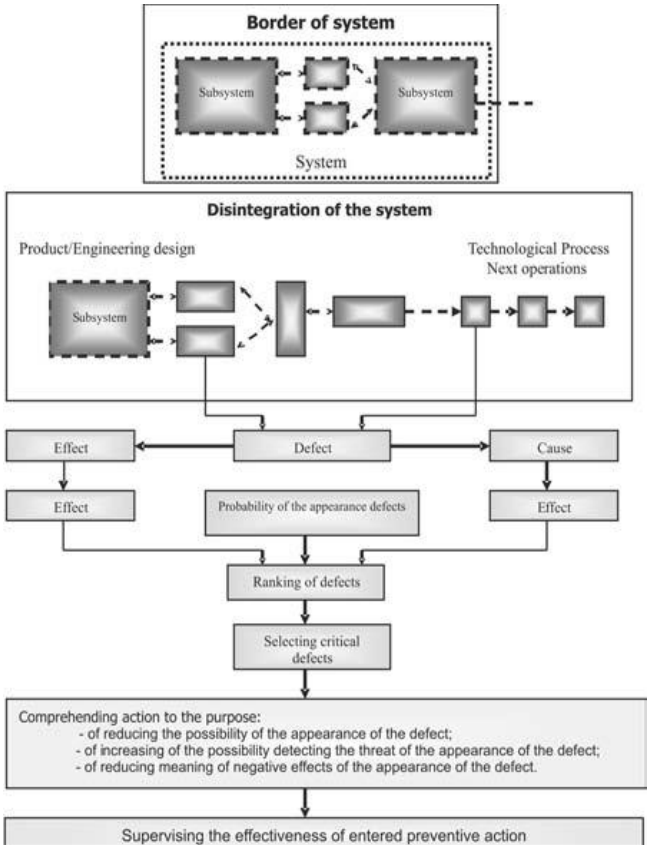
We should use the FMEA method at;

- creating of the product concept, for checking whether all expectations of the customer are included in this concept,
- defining the product, in order to check whether projects, service, supplies are appropriate and organised in the right time,
- process of production, in order to check whether documentation prepared by technologists is fully carried out,
- of assembly, for checking whether the process of the assembly is compatible with documentation,
- of organization of the service, in order to check whether the product or the service are harmonious with established criteria.

It is possible to divide the FMEA method depending on the category of the examined problem, to the following types;

- FMEA of Product/Project according to „base to do well the first time round
- FMEA of Product/Process - producing in harmony with requirements,
- FMEA of production means for guaranteeing effectiveness,
- FMEA of Organization.
- reasons for damage to the product and also effects caused through this damage for the customer, while of the operating of product,
- reasons for coming of the disagreement (with the technical documentation) of produced elements,
- causes of damage during the technological process.

FMEA - of product/design is conducted during preliminary design works in order to obtain the information about strong and weak points of the product, so that at the stage of the conceptual design there still exists a possibility of introduction of amendments.



Defects of the product or the design can concern

- function which the product is supposed to carry out,
- reliabilities of the product during the exploitation,
- easiness's of the service by the user,
- easiness's of repair of the case of damage.

FMEA analysis of the product/design finds applying in cases

- of entering the new product on the market,
- of entering new materials to the production process,
- of applying new technologies in company,
- of great threat to the man,
- of use of the product in particularly difficult conditions.

FMEA of the production process is applied in order to determine factors making it difficult requirements specified in the specification of project design and disrupting normal (correct) process of producing. These factors can concern methods of processing, parameters of processing, measuring-test resources, machines and devices.

FMEA of the production process is most often used

- in the initial phase of planning technological processes,
- before starting the serial production,
- for improving unstable processes in the serial production.

The following covers some basic FMEA terminology.

- **Failure:** The loss of an intended function of a device under stated conditions.
- **Failure mode:** The specific manner or way by which a failure occurs in terms of failure of the item (being a part or (sub) system) function under investigation; it may generally describe the way the failure occurs.
- **Failure cause and/or mechanism:** Defects in requirements, design, process, quality control, handling or part applications, which are the underlying cause or sequence of causes that initiate a process (mechanism) that leads to a failure mode over a certain time. A failure mode may have more causes.
- **Failure effect:** Immediate consequences of a failure on operation, function or functionality, or status of some item.
- **Local effect:** The failure effect as it applies to the item under analysis.
- **Detection:** The means of detection of the failure mode by maintainer, operator or built in detection system, including estimated dormancy period (if applicable)
- **Severity:** The consequences of a failure mode. Severity considers the worst potential consequence of a failure, determined by the degree of injury, property damage, system damage and/or time lost to repair the failure.
- **Remarks / mitigation / actions:** Additional info, including the proposed mitigation or actions used to lower a risk or justify a risk level or scenario.

Stages of conducting FMEA analysis :

Preparation:
defining the purpose, creating the team
Due analysis:
A. Qualitative analysis
B. Quantitative analysis
This analysis consists at estimating factors of the risk and determining the value of R numbers, Z, W and P, meaning one by one:
P number - frequency of appearing of the defect (risk of the appearance of the defect), determined in the scope from 1 to 10,
D number - level of the detect ability of the defect, determined in the range from 1 to 10,
S number - meaning of the defect (for the customer), value in the range from 1 to 10,
R number - number of the priority P = R*W*Z, taking value from 1 to 1000.
Step One: Select a process to evaluate with FMEA
Evaluation using FMEA works best on processes that do not have too many sub processes.
Step Two: Recruit a multidisciplinary team
Be sure to include everyone who is involved at any point in the process. Some people may not need to be part of the team throughout the entire analysis, but they should certainly be included in discussions of those steps in the process in which they are involved.
Step Three: Have the team meet together to list all of the steps in the process
Number every step of the process, and be as specific as possible. It may take several meetings for the team to

complete this part of the FMEA, depending on the number of steps and the complexity of the process. Flowcharting can be a helpful tool for outlining the steps. When you are finished, be sure to obtain consensus from the group. The team should agree that the steps enumerated in the FMEA accurately describe the process.

Step Four: Have the team list failure modes and causes

For each step in the process, list all possible "failure modes"—that is, anything that could go wrong, including minor and rare problems. Then, for each failure mode listed, identify all possible causes.

Step Five: For each failure mode, have the team assign a numeric value (known as the Risk Priority Number, or RPN) for likelihood of occurrence, likelihood of detection, and severity.

Assigning RPNs helps the team prioritize areas to focus on and can also help in assessing opportunities for improvement. For every failure mode identified, the team should answer the following questions and assign the appropriate score (the team should do this as a group and have consensus on all values assigned):

- **Likelihood of occurrence(P)**: How likely is it that this failure mode will occur? Assign a score between 1 and 10, with 1 meaning "very unlikely to occur" and 10 meaning "very likely to occur."
- **Likelihood of detection(D)**: If this failure mode occurs, how likely is it that the failure will be detected? Assign a score between 1 and 10, with 1 meaning "very likely to be detected" and 10 meaning "very unlikely to be detected."
- **Severity(S):** If this failure mode occurs, how likely is it that harm will occur?Assign a score between 1 and 10, with 1 meaning "very unlikely that harm will occur" and 10 meaning "very likely that severe harm will occur." In patient care examples, a score of 10 for harm often denotes death.

Step Six: Evaluate the results. To calculate the Risk Priority Number (RPN) for each failure mode, multiply the three scores obtained (the 1to 10 score for each of likelihood of occurrence, detection, and severity). Score will be 1 and the highest 1,000. Identify the failure modes with the top 10 highest RPNs.

These are the ones the team should consider first as improvement opportunities.

To calculate the RPN for the entire process, simply add up all of the individual RPNs for each failure mode.

Step Seven: Use RPNs to plan improvement efforts. Failure modes with high RPNs are probably the most important parts of the process on which to focus improvement efforts. Failure modes with very low RPNs are not likely to affect the overall process very much, even if eliminated completely, and they should therefore be at the bottom of the list of priorities.

If the failure mode is likely to occur:

- Evaluate the causes and see if any or all of them can be eliminated.
- Consider adding a forcing function (that is, a physical constraint that makes committing an error impossible, such as medical gas outlets that are designed to accept only those gauges that match)
- Add a verification step
- Modify other processes that contribute to causes.

If the failure is unlikely to be detected:

- Identify other events that may occur prior to the failure mode and can serve as "flags" that the failure mode might happen.
- Add a step to the process that intervenes at the earlier event to prevent the failure mode.
- Consider technological alerts such as devices with alarms to alert users when values are approaching unsafe limits.

If the failure is likely to cause severe harm:

- Identify early warning signs that a failure mode has occurred, and train staff to recognize them for early intervention. For example, use drills to train staff by simulating events that led up to failure, to improve staff ability to recognize these early warnings.
- Provide information and resources, such as a reversal agents or antidotes, at points of care for events that may require immediate action.

DETECTION TABLE;

Rating	Meaning
1	Certain - fault will be caught on test
2	Almost certain
3	High
4	Moderate
5	Low
6	Fault is undetected by Operators or Maintainers

General Detection Table

SEVERITY TABLE;

Rating	Meaning
I	No relevant effect on reliability or safety
II	Very minor, no damage, no injuries, only results in a maintenance action (only noticed by discriminating customers)
III	Minor, low damage, light injuries (affects very little of the system, noticed by average customer)
IV	Moderate, moderate damage, injuries possible (most customers are annoyed, mostly financial damage)
V	Critical (causes a loss of primary function; Loss of all safety Margins, 1 failure away from a catastrophe, severe damage, severe injuries, max 1 possible death)

VI	Catastrophic (product becomes inoperative; the failure may result complete unsafe operation and possible multiple deaths

General Severity Table

OCCURENCE TABLE;

Rating	Meaning
I	The appearance of the defect is almost impossible.
II	The defect very rarely appears.
III	The defect appears occasionally, every now and then.
IV	The defect often appears.
V	Almost it isn't possible to avoid the defect

Benefits arising from FMEA applications;

- Improve the quality, reliability and safety of a product/process
- Improve company image and competitiveness
- Increase user satisfaction
- Reduce system development time and cost
- Collect information to reduce future failures, capture engineering knowledge
- Reduce the potential for warranty concerns
- Early identification and elimination of potential failure modes
- Emphasise problem prevention

An improvement in the quality of the created system is a superior aim of the FMEA method. We get the following results thanks to her: identification of the influence of damage element on other elements, subsystems and the entire system, determining means lowering the risk, the verification or supplementing the specification of requirements for the system, gain in time and costs, thanks to the identification of possible threats still before the accession of the to do system, assisting the process, making its way for better understanding the system (in particular FMEA), can constitute the ground for drawing up service and diagnostic proceedings), creating conditions for FMEA analysis of superior systems, in which the given system was applied, documentation of all ideas concerning the answer given to the reliability, documentation of acquired experience, problems and their solutions for next projects, reduction in the scope of warranty repairs.

The practical application of FMEA method in moulding industry

Economic activity of chosen moulding company - the producer of mould products - is directed permanently assuring of their qualities, reducing negative influence on the environment, guaranteeing the safety in all action as well as ensuring resources for the implementation of adopted the quality politics. The above purposes should be realized thanks to follow agents:

- keeping staff competent, still increasing its qualifications formed in over 170 years of tradition of the company opinion on permanent fulfilling requirements of customers,
- applied and constantly improved methods of the industrial engineering based on new safe technical solutions, technological and organizational, including also the control and preventing the environmental pollution,
- abiding by norms being in effect and provisions of law in the quality of the production, environmental protections and the industrial safety,
- applied in the production exclusively methods tested, substantiated, guaranteeing the safe service and optimizing wearing out raw materials and energy media of the production,
- constant monitoring processes of producing, conditions of the work and the influence on the environment through: planning the quality of produced products, preventing accident at work, applying means of the collective protection, reducing emission dust -gas from burning the natural gas in technological processes, limiting the amount of stored waste, preservation of surface waters.
- cooperating and keeping the permanent contact with suppliers and customers for permanent providing for the quality products, as well as with outside individuals within the scope of introducing technologies safe and friendly to the environment; permanent promotion of achievements within the scope of the quality, environmental protections and the industrial safety.

Warranty of achieving the high quality of products and reducing the negative influence to the environment with guaranteeing the constant improvement in the health and safety at work of the staff is supporting integrated systems of the management.

Using the FMEA method in the preproduction

Decisions to apply FMEA has been undertaken by Chief Technologist. FMEA is led in the case:

- interests of the customer in the purchase of products of the mill with parameters different than standard,
- of preparing for the production of new or modernised products,
- of significant amendments to the technology,
- analyses of causes of existing defects in products and processes.

FMEA analysis is conducted team of FMEA, which consists of:

1) Chief Technologist chairing of FMEA team,
2) Production manager,
3) Main Mechanics,
4) Manager of Quality Department.

Criterion of analysis	Functional ownerships of the product while having right of usage.	Course of the process (technological, logistic).
Object of analysis	The entire product, sub-assemblies, parts.	Phases of trials of processing and of assembly (operations, treatments, activities).
Questions, to which he infects the reply	What causes can cause the complete or partial disappearance of the given function of the product. What effect can be associated with it?	What defects (problems) can turn up at a given stage in a process and what their influence on defect in the product can be
Examples of expressions of defect	Crack of the element. A contact is missing. A medium lacks the flow.	Dimension outside the field of the tolerance. Too low hardness, wrong estate
Examples of expressions of cause of defects	Mistakes of the structure. Wear and tear. Mistakes of the service. Influence of surroundings.	Mistakes of the device/machine. Human errors. Wrong methods. Wrong material.
Examples of expressions of effects	Breakdown/disappearance of the post. Reduction performance	Variance with requirements. Reduce productivity.

FMEA analysis is conducted according to the knowledge and experience of FMEA team members based on databases. The preliminary steps covers: evaluation of the current state, establishing correct/preventive action, verification of the result. As a result of arrangements of the preliminary stage FMEA team define potential defects. In the next steps FMEA team assignees causes of defects and determines causes coming into existence of defects. Causes of defects should consider a point of view of the customer, taking into account the predicted reaction of the customer to the defect discovered by him.

Causes of coming into existence of defects should think over comprehensively so that in the simple way it is possible to determine essential preventive action. The current result of workshop of FMEA team are presented in FMEA sheet. Arrangements of the preliminary stage are subject to an archiving in company together with the rest part of documents, which arise in the course of the FMEA team activity. Chief Technologist archives and keeps a register of FMEA analysis. The evaluation of current state including tools research and establishing the risk of the production with the help of the priority number.

RPN=P ×D×S

where,

P=Probability of occurrence of defect.

D=Detection of defect.

S=Severity of defect.

Every of priority numbers means the probability of appearing of the determined defect in the scale of 1-10. Results of the work of the FMEA team are put down on the FMEA sheet. Correct/preventive action is withdrawn in the relationship to every stated or potential defects. On account of the possibility of getting notable effects FMEA team accepts the hierarchy of planned correct/preventive action oneself than RPN biggest to the RPN low figure. The leader of the FMEA team sets the date of the verification of the performance depending on established dates correct/preventive action. In case of the lack of the anticipated effects of correct/preventive action reducing RPN number to acceptable level - new action is appointed and therefore a new date of result verification should be established. Such activities should be performed in the continuous cycle for achieving the value of number RPN on the satisfying level defined by FMEA team. The finishing of the work of the FMEA team on the specific problem should be announced at the meeting with Quality Manager.

FMEA IN PRACTICE: ANALYSIS OF POTENTIAL DEFECTS IN MOULDING PROCESS

FMEA analysis for determining defects in the production process of moulds or plastic parts. All operations with FMEA analysis has been presented in FMEA Sheet.

- In first column possible defects that can occur in production are defined.
- Next column describe causes of defects in products.
- Effects of defects are defined in next column.
- Now values for severity, occurrence, and detection with calculated RPN value are given.
- Fmea team now analyse the action recommended to reduce the defects.

- After applying changes required in process and production new values for occurrence, severity and detection are recorded .
- New RPN estimated and compared with last RPN
- If new RPN got reduced then we can fmea team reduced the defects in products and improved the process.

Process defect	Potential failure causes	Potential failure effects	SEV	OCC	DET	RPN	Percentage RPN	Actions recommended	Actions takn	NEW SEV	NEW OCC	NEW DET	NEW RPN	New RPN Percentage
Moulding flash	Worn or poorly fitting cavity/mould plates, Over packing, Improper venting	Customer dissatisfaction, Product liability, High return rate	4	3	2	24	0.24	Ensure correctly fitting mould plates, Vent appropriately, Avoid over packing	Before production	3	2	2	12	0.12
Moulding warpage	Non-uniform cooling, Temperature differences, Machine variations	Customer dissatisfaction, Loss of material	4	3	5	60	0.6	Use thinner wall sections with ribs, Change material	Before production	3	3	3	27	0.27
Moulding air trap	Racetrack effect, Hesitation, Unbalanced flow paths	Customer dissatisfaction, High rejection	5	4	4	80	0.8	Balance flow paths, Balance runners, Vent appropriately	Before production	3	2	4	24	0.24
Sink mark and void	thermal contraction (shrinkage) during cooling, Insufficient material compensation	Wastage of material, More rework	6	4	4	96	0.96	Optimize packing profile, Reduce volumetric shrinkage, Optimize the runner system design	Before production	4	3	3	36	0.36
Crack	High residual stresses, Weld line weaknesses,	Customer dissatisfaction, Product liability						Minimize residual stress, Check for the recommended maximum shear stress ,	Before production					
	Differential shrinkage	High return rate						Minimize differential shrinkage						

			6	4	4	96	0.096			3	3	2	18	0.18
Brittleness	Material degradation, Weld line weaknesses, Incompatible materials blended together	Product tends to break or destroy, Can be dangerous to user, Customer dissatisfaction	6	4	3	72	0.72	Reduce regrind material, Modify screw design, Strengthen weld lines, Reduce residual stress	Before production	4	2	2	16	0.16
Discoloration	Material degradation, excessive injection speed, residence time, melt temperature	Customer dissatisfaction Product liability High return rate	4	3	3	36	0.36	Modify screw design, Optimize melt temperature, Optimize the runner system design, Optimize back pressure	Before production	3	2	2	12	0.12
Short shot	Flow restrictions, Machine defects, blocked feed throat, channels freezing	Loss of material and time, Malfunctioning of assembly due to defected part	5	4	2	40	0.4	Avoid hesitation, Increase mould & melt temperature, Eliminate air traps, Change material, Increase the maximum injection pressure for this part	Before production	3	2	2	12	0.12
Excessive part weight	Over packing, Unnecessarily thick wall section	Increases production cost, Additional cost of the material						Avoid over packing, Use thinner wall sections with ribs, Design a part to be made by gas injection moulding	Before production					
			4	4	3	48	0.48			2	2	3	12	0.12
Dimensional variation	Inconsistent shrinkage,	Product will be of no use,						Remove excessive moisture,	Before production					

	Material variations such as property variations, Process conditions variations	Over head of rework, Assembly will not work properly, Performance degradation	6	3	2	36	0.36	Reduce regrind material, Replace the check ring if it is broken or worn out, Ensure uniform mould temperature		4	2	2	16	0.16
Black spots	Adiabatically heated trapped air, Air trapped in pockets may compress, heat up and cause burn marks. Material degradation, Excessive injection speed	Customer dissatisfaction Product liability High return rate	4	3	2	24	0.24	Eliminate air traps, Modify screw design, Restrictive runner, gate, or even part design could cause excessive shear heating that aggravates an already overheated material, causing material degradation.	Before production	3	2	2	12	0.12

Solving one problem can often introduce other problems to the injection moulding process. Each option hence requires consideration of all relevant aspects of the mould design specification.

SUMMARY

In the enterprise of the future, besides the quality and the innovation, undoubtedly an important role efficiency of activity of the company action is played by towards with customers, because it is they will be the greatest good for the company. It means that it is necessary to implement the systematic planning, the effective control and managing of individual processes in the enterprise. Thanks to that it will be possible to make right decisions, and the area of the uncertainty will shrink. That is not the point only about quality management and quality management system, but also for appropriate choice of developmental decisions of the enterprise. Functioning of enterprises in current time is exposed to a lot of adversities resulting from the market. In the moment, when the level of the income from the sale is established on the certain, or fixed level, but marketing action doesn't influence the turnover, enterprises resort to amendments inside the organization. Implementing the system of the quality management, and consequently integrating it with the environmental system and safety system constitutes a factor of the success, surviving and the development of the enterprise.

Paying attention to the aspect of continuous improvement by the enterprise with using of quality techniques and quality evaluation methods of every sphere of company's action, particularly the preproduction sphere, will do good for increasing the competing position on the market. The next as reducing costs, minimizing the potential defects in the process and bigger fulfilling expectations of customers. Applying the

FMEA method allows for enhancing the possibilities of the enterprise. Significant integration of employees takes place. And it causes that is started "Machine of ideas" what give in the end final „ plan perfect almost ". Thanks to the efficient system of quality management a company develops. This process is supported by efficient quality method as FMEA. Based on this method the company gains good results in the production process.

This method combines the possibility of supervising many activities of branch with the simultaneous delegation of entitlements and the decentralization of the power which are necessary for effective functioning of individual divisions of company. FMEA method is an important method of preventive quality and reliability assurance. It involves the investigation and assessment of all causes and effects of all possible failure modes on a system, in the earliest development phases. Usage of quality research methods -specially FMEA method - in preproduction sphere in Polish companies permits an avoidance of occurrences of productive defects already in the first stages of product cycle, which helps in elimination of source of their formation.

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