The Industry 4.0 technological safety

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Abstract. The production processes have some negative consequences for the environment. The potentially ecologically dangerous technologies and equipment require a constant attention from the company board and the controlling State structures. The technical means to provide the production technological safety equal to the appearing technological risks are engineer cyber-system (ECS) to neutralize toxins throwing away to the nature. The ECS support the company life ability and locally placed in categorized production rooms given for auxiliary equipment. The company production and ECS procedure algorithms are done with the intellectual production system to react operatively for critical values of emergencies with negative ecology influences. The production infrastructure conditions correct evaluation is reached with ECSs inquiry to prevent the emergencies from happening. There is a system to classify ECSs, which provide the company technological safety. There is ecologically safe automatic cyber-production architecture where the most efficient format is done with three coils, which constantly interact in production components.

1. Introduction

The Industry 4.0 global production paradigm today has received new defiance of the society high attention to preserve the environment for the humanity. The technological progress obstacle is the International Laws requirements to direct the question of the automatic production ecological safety [1, 2].

The industrial objects to complete the complicated production cycle are from the company category of high danger class because some emergencies of technological nature may appear and propagate [3]. The production factors influence for the environment could be different including the vast industrial territories contacting with nearby water deposits, sewers communications, electric systems, wind blowing masses and other [4, 5].

To project an ecologically safe production is based on a lot of mathematical calculations including all possible options of technological emergencies scenarios, the level of the being thrown in the environment substances danger and sanitation and epidemiology norms for actively industrial regions [6]. To provide ecological production safety they have a number of technical means being mounted in different company parts as the engineer infrastructure [7, 8].

The production object base infrastructure component is an engineer cyber-system (ECS), which provide the well conditions for the production cyber-system (CS) functioning and the general company...
ecological safety [9, 10]. Physical, chemical and mechanical processes of the engineer infrastructure CS are different so that why there is a wide range of ECSs for the company auxiliary functions [11, 12].

The inner engineer systems traditional sub-classes widely used in the Industry 3.0 company are useless today to provide the Industry 4.0 production objects safety and that why the following tasks are actual [13, 14]:

- to develop the classification system of ECSs to provide the Industry 4.0 new production objects vitality and to minimize the emergencies appearance risks, which are critical for the ecology;
- to integrate the different ECSs into production infrastructure to guarantee the industrial cyber-installations exploitation safety for the environment and human health.

2. The ECS classification

The modern automatic production ecological safety provision includes a wide range of important tasks like the company engineer infrastructure. The company engineer infrastructure includes [12, 15]:

- the company cable system to commutate the production cyber-equipment high potency currents, electric light and low potency chains for telephonic, wireless connection and other;
- a system of cleaning facilities to provide the industrial running waters neutralizing made with technological production wastes and household wastes with the sources of chemical and biological contaminations;
- a system of inlet and outlet ventilation to provide the clean air masses and tides company circulation containing toxic materials vapor and gases substances of technological origin;
- a system how to handle solid industrial wastes made after technological processes with left-overs (cut-offs) of the original raw materials;
- a fire extinguishing system to provide the fire detection, localization and operative fire extinguishing into the company production rooms;
- the safety alarm system to provide the production objects physical (functional) and informative safety and its components with vital data for a continuous technological cycle;
- an energy system to form a continuous and secure electrical supply for all industrial consumers using industrial currents and other.

A system to classify ECSs is given in figure 1. The ECSs technological safety defiance provides a closed cycle of wastes handling to form in the company the different combinations of aggregate conditions: worked out air, liquid substances and solid wastes of non-finished production products. To control the company wastes is done with intellectual environment programmed to form minimal (in limit cases zero) throw-outs contaminating the environment.

The cyber-production (CP) intellectual environment makes a scrupulous control of all industrial company technological safety risks factors, which could destabilize the nature ecological balance. To prevent sanitation and epidemiology rules and norms breaking is done in production as a system of plan actions to liquidate non-organized throw-outs and to organize in inner rooms the responsible sections of protection as a multi-step wastes neutralization.

ECSs are installed in locally isolated rooms (air filters, cleaning facilities of water throwing and other) and in middle rooms (fire extinguishing means) for production CS to realize the physical and chemical processes which form industrial toxins. To reduce the number of throw-outs into the environment they apply ecologically safe production technologies with ECSs connected as modules and using the wastes recycling ways, which were never used before.

The environment preservation directly depends on the low cost resources preserving resources technologies development, which is the base of ECS functionality in an automatic production. The production processes technological safety is maximum efficient for carefully engaged region natural conditions, which may help in far future create something like a scaled industrial object of non-wastes nature.
Figure 1. The ECSs system classification to neutralize the toxic substances and utilizing the industrial wastes non-useful for recycling.

3. The CP safe environment
To integrate the ECS into the current production infrastructure requires some changes of each room architecture plan of its construction and montage works. The production ecology safety requirements must unite intellectual and non-intellectual engineer equipment into a single cyber-monitoring system, which must unite the potential risk of technological emergency minimizing. The ecologically safe CP is formed with three net coils of primary and auxiliary CS:

- the production CS physical net uniting industrial machines into a conveyor chain;
- the ECS physical net uniting the electronic means to prevent an emergency and preventive equipment breakage detection devices with highway water and air communications;
- a mobile net of control and measuring sensors, which react with the production important technological processes.
The brain center of ecologically safe CP is the intellectual system deployed on company server assets to accompany the potentially dangerous surges in automatic CS functionality. The CP destabilizing factors could be any industrial equipment faults which make a higher risk of technological emergency appearance. The ecologically safe cyber-production architecture is given in figure 2.

![Diagram](image)

**Figure 2.** The ecologically safe CP architecture.

The existing way of huge industrial objects placement in sites of some hundreds square kilometers is not particularly useful for an ecologically safe CP. The environment positive effects may be expected from the automatic equipment placement to minimize the space being occupied in a production room.

4. **Conclusion**
The technological emergency industrial company inner objects protection is provided with the cyber-monitoring intellectual system to congregate the data generated from the ECS distant inquiry mode. ECSs with the genetics certificates ecological standards correspondence forming an echelon complex of technical protection means to minimize the living organisms destructive actions risks. The emergencies potential factors with environment production danger are:

- aggressive technological liquids into open water reserves and grounds from house hold and production collectors as an non-sanctioned water release;
- the worked out air masses with high toxic influence substances concentration, which penetrate into the nature with convention means through natural and technical ventilation channels;
the solid industrial wastes including hazardous materials of low decomposition with a slow catastrophic damage to flora and fauna.

The hazardous materials generation is a part of daily industry activity, which in operational level uses the ecology hazardous technologies. The production toxins cumulative effect leads to not replenished ecological losses formation, which consequences normally are some territories living uselessness, which are near the industrial objects.

The regional scale emergency appearing risks deserves a close attention from the State who is interested to develop the economy in ecology oriented way. The State ecology industrial politics priority must be the human rights preservation to live in a safe area, which does not have any destructive industrial influence. The company, which supports the ecologically hazardous production technologies must be taxed in high rates and the person who organized the technological emergency must be reasonably fined, which are equal to the damage done to the environment.

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