- ***Construction corrosion of poultry meal production hall***

INTERIOR METAL CONSTRUCTIONS

Most of the constructions in the technological hall was protected with hot dip zinc coatings. Among volatile poultry proteins destruction components which are corrosion active are hydrogen sulphide, ammonia and organic sulphur compounds. Zinc coatings on the constructions were in a good condition after 4 years, but there was corrosion at places of mechanical or thermal coating damages and locally under the ceiling within the outgoing gas stream. Main constructions were in a good condition if only zinc coating was untouched. Some of zinc coatings underwent abrasion on railings, stands, montage places, or were thermally damaged due to welding, after which rusting appeared. Rusted surfaces should be cleaned without delay and covered with two layers of a paint loaded with zinc dust.

Steel without zinc coating, or steel re-welded was attacked by uniform corrosion. Locally deposited poultry powder can not be easily differentiate from iron rust. Deposited powder can be removed with hard brush. Rest of the powder can be removed with wet mops. Removal of rust requires wire brushes. In the case of doubts the deposited zinc coating thickness can be measured using magnetic probe or rust can be identified by ferroxyl test (with potassium ferric cyanate).

The construction condition within the poultry meal production hall is presented in the photographs below.

Fig. 1. Galvanized steel constructions in the Production Hall contaminated with poultry meal were free from rust. Aluminium mantels over piping was with no corrosion signs.

Fig. 2. Poultry meal deposited on the galvanized steel constructions can not be easily differentiate from iron rust.

Fig. 3. Coating thickness test performed after removal of strongly adhering deposit showed that zinc film thickness was with no change.

Fig. 4. There were few places on the constructions, for instance after re-welding, covered with rust. Renovation after mechanical cleaning should be done with a paint loaded with zinc dust..

Fig. 5. Corrosion of construction elements including sandwich panels consisting of hard mineral wool core covered with galvanized and painted steel plates rusted within the flow stream of aggressive gases.

Fig. 6. Threat of corrosion cracking of rusted steel rod threaded parts due to continuous stress.

Fig. 7. Rusted rods without protective coatings may be affected by stress corrosion cracking.

EXTERNAL AND ROOF CONSTRUCTIONS OF PRODUCTION HALL

Rooflight domes with pneumatic opening system Were installed on the flat roof of the hall. Construction elements were protected with a paint coating having thickness around 30 µm. The thin paint film did not protect steel against humid warm outgoing gases and external atmospheric conditions. Many internal metallic surfaces of the rooflight dome bases had the paint coating damaged partly or completely. On rooflight dome surfaces having nearly full damage of the protective coating a thick layer of rust was formed. A number of construction elements used for opening the domes were rusted. Some of the dome glasses were broken. Pneumatic actuators and upper frames were made from corrosion resistant material.

Condition of the external and the roof constructions are presented in the photographs below.

Fig. 8. Elements of dome rooflights with pneumatic locking, used for ventilation, were intensively corroded after 4 years at the Production Hall roof.

Fig. 9. Rust at connections between rooflights construction and sandwich panels after 4 years on the Production Hall roof.

Fig. 10. Painted steel plates and rooflights were locally completely destroyed after 4 years on the Production Hall roof.

Fig. 11. Galvanized steel structures with no corrosion; steel screws covered completely with rust after 4 years on the Production Hall roof.

Fig. 12. External ladder steps corroded close to welds

LABORATORY INVESTIGATION OF CORROSION RESISTANCE

Partly immersed steel and galvanized steel plates were exposed in glass bakers with demineralized water saturated with poultry meal at 20° C. The test results are presented in Fig. 13 and 14.

Fig. 13. Steel plates with lower part immersed in water saturated with poultry meal after 50 days exposure. The steel became rusted within vapours above the solution surface. Black deposit on the immersed part.

Fig. 14. Galvanized steel plates with lower part immersed in water saturated with poultry meal after 60 days exposure with no corrosion.

CONCLUSIONS

Most of the steel constructions in the Production Hall was well protected against corrosion. The constructions situated under the ceiling within the stream of the humid warm gases like threaded parts of stressed rods and partly rooflight constructions were rusted. Corrosion of the constructions affected by the gases was uniform without pitting. The laboratory corrosion investigation confirmed good resistance of zinc coatings against wet poultry meal and against gases emitted during the poultry meal production. Zinc coatings corroded slowly as zinc flowers nearly disappeared. Unprotected steel surface that was affected by humid production vapours became covered with rust.

Corroded construction elements in aggressive gas stream required renovation of the protective coatings. Rusted galvanized construction elements should be cleaned using electric drive steel brushes and washed with water containing a detergent. They should be protected with two layers of a paint having high content of zinc dust, applying brushes with a short bristle. Rusted steel screws should be exchanged to galvanized ones or cadmium covered, because the latest have better corrosion resistance.

It was advised to check condition of the coatings on the construction elements under the ceiling at 2-3 years intervals. There was a danger of the stress corrosion cracking of rusted steel rods so that corroded surfaces should be cleaned without delay and protected with a paint loaded with zinc dust. To avoid difficult work at a height these elements should be exchanged to ropes or rods of stainless steel.

The corroded rooflights above the Production Hall should be exchanged the ones durable within the aggressive gas streams. Roof flashings around the rooflights, domes having broken glass and rusted steel sheets on the roof should be exchanged.

Author:

Dr Zbigniew Klenowicz