SETTING UP ANTICORROSION SERVICES IN CHEMICAL PLANTS*

A. L. Labutin

UDC 620.197.008

Rapid development in the country's chemical and petroleum-chemical industries, and also in such industrial areas as pharmaceuticals, paper, etc., require corresponding expansion and improvements in anticorrosion services in various factories. This is even more necessary since the newly developing technical processes are often associated with the use of high temperatures and pressures, and also the use of new chemical substances, the corrosive activity of which has been inadequately investigated.

The extensive drive throughout the country for improving the reliability and life of industrial equipment has special significance for the chemical industry since these problems have a direct bearing on safety techniques as well as economics. All this enhances the role and importance of corrosion engineers in the factory. Meanwhile, in the setting up and functioning of anticorrosion services in our factories, there are many inadmissible gaps which will not be discussed here since they are very well known.

Existing drawbacks are largely connected with the absence of standardized management methods, and also typical specifications determining the responsibilities of specialists setting up anticorrosion services. In connection with this and particularly at present, when the concerns are given extensive economic and financing independence, it is desirable to make a comprehensive assessment of the setting up of anticorrosion services in chemical factories in order to find rational forms and approaches (resulting from wide-range discussions) which would be technically and economically acceptable for most chemical and allied concerns.

Below we present for our readers' examination and assessment various schemes for setting up anticorrosion services in factories with large and limited numbers of anticorrosion processes (Figs. 1-2), and make an attempt to outline the area of responsibilities of the people tackling the corrosion setup in production equipment and newly built equipment, and those responsible for corrosion research of an applied nature.

In Scheme 1 we propose the setting up at the factory of a corrosion services division headed by the departmental chief – the senior engineer – on corrosion technology. Under his authority, in addition to several technical workers, there will be three corrosion engineers who in essence are his assistants. One of these engineers deals with problems of the anticorrosive protection of industrial equipment, another looks after the reliability state of building equipment, and the third is responsible for the state of affairs in the underground workings.

In factories that have to carry out a large number of anticorrosion processes there should be an anticorrosion department with appropriate divisions, for example, rubberizing, painting, lining sections, etc. The latter can be headed by technicians or even foremen, that is, specialists not coming under the categories of instrument and control workers (ITR), under conditions where the departmental chief and his assistant are engineers. The staff of anticorrosion departments may vary for different factories in very wide limits, but they can hardly include less than 30 people, since many technological operations (vulcanization, polymerization, etc.) require two-three shift operation.

The central laboratory of the factory, according to Scheme 1, contains a corrosion laboratory with a staff of approximately 12-15 people, which is headed by the manager, a corrosion chemist.

The relationships of the various organizational units with each other, and also with the production departments, are shown in Scheme 1 by the broken lines. These relationships consist of daily discussions and association. The administrative subordination (continuous lines) flows from the staff secondment of

* In the nature of a discussion.

S. V. Lebedev All-Union Synthetic Rubber Research Institute. Translated from Zashchita Metallov, Vol. 4, No. 1, pp. 96-101, January-February, 1968. Original article submitted August 28, 1967.

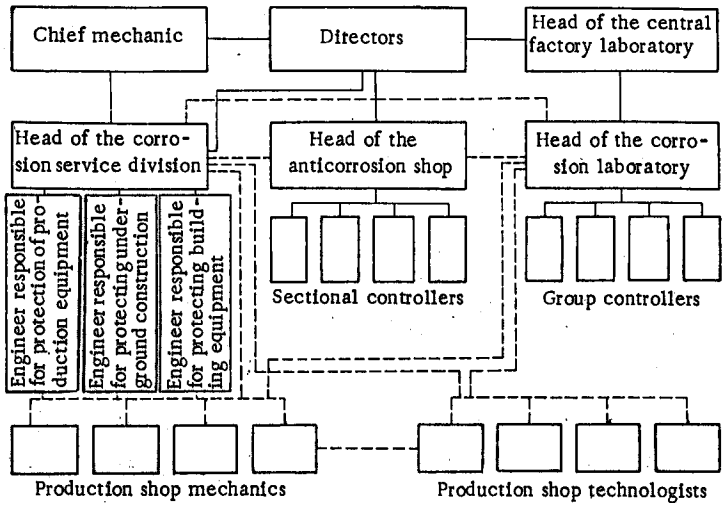


Fig. 1. Scheme for anticorrosion services in a factory carrying out a large amount of anticorrosion work.

the specialists to any particular division. Thus, corrosion engineers come under the head of the anticorrosion services division, and the chief of the corrosion laboratory under the head of the central factory laboratory. The head of the anticorrosion shop, which may contain large divisions, as shown in Fig. 1, and as for other departmental heads, is directly subordinate to the directors.

When the factory undertakes only a small amount of anticorrosion work (Scheme in Fig. 2) it is sufficient to have one senior corrosion engineer in the chief mechanic's section. The central laboratory of the factory in this case provides only a corrosion group, consisting of four-five people, including the manager.

In factories which have to tackle only a limited amount of anticorrosion work the existence of an independent anticorrosion department is not necessary. In this case, work to do with protecting the equipment and building plant can be done by the efforts of the anticorrosion foreman, working in the mechanical-repair shop of the factory. The manager of the anticorrosion section can count as his staff the deputy head of the mechanical-repair shop responsible for anticorrosion jobs.

Whichever of the above Schemes the anticorrosion services use as their basis in the factories, the central and critical figure should always be the senior corrosion engineer. He records, plans, and implements all the protective measures for guarding against equipment corrosion and corrosion in building equipment, and also coordinates and controls the anticorrosion jobs carried out in the factory both by the factory's own resources and also by associated specialist organizations.

In accordance with this, the senior corrosion engineer, independently or with the participation of workers from the anticorrosion services section, carries out the following specific jobs.

1. He takes part as the corrosion specialist in the project-design operations that are completed in the project-design section of the factory for setting up new equipment or reconstruction of existing ones. He is responsible for the proper choice of corrosion-resistant materials or protective coatings; he looks over the plans for building equipment, designed for operation in conditions liable to be corrosive.

2. He observes the proper installation of equipment and communications, and also erection and building work in connection with production buildings, to prevent errors contributing to the development of corrosion (replacing metal of one type with another, inadmissible combinations of various metals, improper welding, substandard separation of structural elements from production media or drainwater, etc). The quality of lining, painting, and other anticorrosion work completed by institute or factory organization should be controlled by him.

3. He takes note of the state of equipment, pipelines, armatures, control and metering apparatus, and other equipment operating in contact with corrosion-erosive media or submerged in the ground.

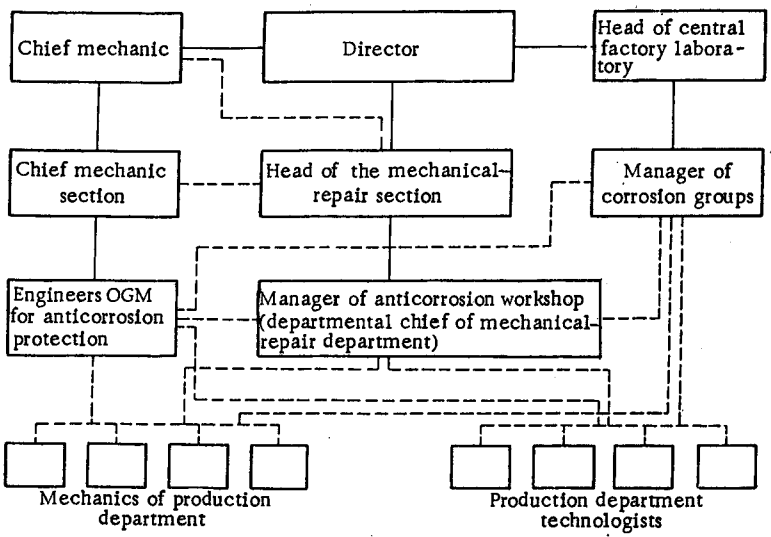
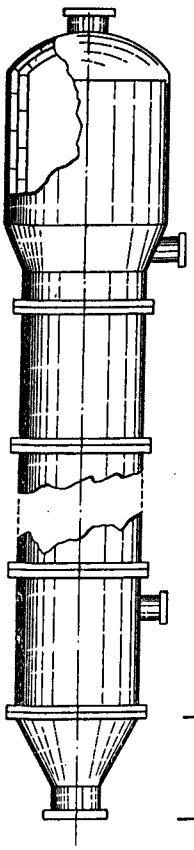


Fig. 2. Scheme of anticorrosion services at a factory with few anticorrosion tasks.

Checks are made on the state of building constructions and the necessary measures taken for preventing corrosion as a result of the action of corrosive production effluent, drainage, or industrial atmospheres.

In conjunction with the mechanics in production departments and the head of the anticorrosion shop, he compiles and periodically corrects corrosion charts for all corrosion equipment which may be subjected to corrosive wear. He makes up plans for the completion of measures aimed at eliminating corrosion or reducing it to the absolute minimum, striving in the first instance to use those materials and methods which have proved themselves in allied chemical concerns.



He does systematic work to save nonferrous metals, and also high-nickel steels and other expensive or scarce metals and alloys, by introducing bimetals, low-nickel steel substitutes, plastics and coatings, corrosion inhibitors, and other modern protective agents.

4. He keeps a check on the repair department handling equipment, production shops and underground pipelines without permitting damage which could lead to rapid corrosion, erosion, or cavitational destruction.

5. Together with the corrosion laboratory or group, he investigates the corrosiveness of the raw materials used in the plant, semiproducts, and finished goods, and develops measures to prevent the corrosion of equipment and containers, or the contamination of the chemical reagents processed at the factory by corrosion products during their processing, storage, and transport to the users.

6. He provides systematic consultation and other assistance to the anticorrosion departments or to the foreman in connection with choosing the most resistant and economical materials and the introduction of new progressive methods and instruments, and also the most reliable methods of controlling the quality of anticorrosion projects.

7. He calculates and clarifies the economic effectiveness resulting from the introduction of anticorrosion measures.

Fig. 3. Cylindrical apparatus 20 m high and 1 m in diameter assembled from five sheet cylinders. It has a conical base and an expanded upper section. The external side is fitted with a circulation pipe made from Kh17N13M2T steel.

8. He participates in compiling annual lists of anticorrosion materials (lacquers and paints, plastics, rubber, adhesives, etc.) and working instruments and apparatus used in corrosion control. Controls are exercised for reserving these materials in factory warehouses without permitting rule breaking, as specified by the technical specifications.

9. He sets up relationships with the corrosion laboratories in regional and other scientific research and project institutes and allied factories, and organizes teams of workers in factory corrosion services at the advanced concerns specializing in questions of anticorrosion protection.

10. He plays a part in holding conferences, scientific-technical meetings, and seminars to deal with corrosion throughout the country. The results of conferences are discussed at gatherings of workers in the factory.

Various methods of technical propaganda for informing the workers about measures for dealing with corrosion are drawn up.

He gives consultations and other technical assistance to rationalizers and inventors dealing with corrosion.

11. He participates in work dealing with the compilation of instructions and measures dealing with safety techniques, especially those dealing with anticorrosion work.

12. He compiles a complete and contemporary collection of factory and technical publications dealing with corrosion and protection, and also gives advice for better use of this information.

13. He prepares annual and semiannual notes and also other forms of reports for the higher authorities, giving information about the average activity of the factory in its drive against corrosion, including work completed in the anticorrosion departments, and research completed in the corrosion laboratory, etc.

The following problems should be tackled in the corrosion laboratory or group.

1. Investigations of corrosion activity of the liquid and gaseous media processed at the factory. The development of different methods of reducing their corrosive activity to the permitted minimum (for example, by introducing inhibitors or neutralizing substances, changing the concentrations and temperatures, removing agents of corrosion or stimulative impurities, etc).

2. Investigation into the causes of important cases of electrochemical or chemical corrosion of equipment, pipelines, and other factory equipment that are of interest for production or scientific research.

3. Investigation of the corrosion resistance of new metals developed by industry (low-nickel steels, titanium and its alloys, etc.) in actual production conditions and comparing and compiling recommendations for their use.

4. Investigation of chemical resistance of nonmetallic materials and anticorrosion properties of coatings, applied to the environment of the factory, and compiling recommendations for the use of these materials.

5. Study of chemical and thermal resistance of new building and sealing materials and compilation of recommendations for their use.

6. Regular checks of the basic operational properties and, where necessary, compositions of various anticorrosion materials used by the anticorrosion workshops if their quality gives rise to doubt. The completion at the request of the anticorrosion department or shop foreman of control measures on coatings made from lacquers, paint, rubber, plastics, and other anticorrosive materials which are used or proposed for use at the plant.

7. Participation in the compilation of corrosion charts at the factory for equipment in those cases where it is necessary to involve chemists in this work.

8. Participation in conferences, scientific-technical conferences, and seminars dealing with corrosion

In conclusion we give a typical corrosion chart for equipment operating in heavy corrosion conditions and specimens of notes in it drawn up after the control examination, based on experience accumulated by the synthetic rubber industry (Fig. 3).

Editorial Note: The above article by A. L. Labutin is published in the hope that workers in chemical factories and also specialists in allied scientific research and project institutes and the corresponding government organizations will play an active part in discussing the real problems raised by this article.

Corrosion Chart No. 3

Acetylene hydration department.
Name of equipment: Hydrator
No. of equipment in the production scheme: 4
Name of equipment: Reactor for obtaining . . . . acetaldehyde from acetylene . . . . . .
Material for making the equipment: St. 3 steel
Protective coating: double-layer lining of diabase tiles laid on acid-resistant silicate mortar with a sublayer of 2566 rubber, stuck to steel with 4508 + 2752 adhesives.
Narrow connecting pipes are protected with inserts (sleeves) made from Kh17N13M2T steel, laid on acid-resistant silicate mortar.
Gasket is made from 2566 rubber.
Corrosive conditions: Atmosphere acetylene, water, acetaldehyde, and contact acid of the following composition: % by weight, $FeSO_4$ 0.1–0.25; $Fe_2(SO_4)_3$ 17-22; H_2SO_4 5-8; $HgSO_4$ 0.2; temperature 96-98°, pressure < 1 atm.

First list

Notes.
Results of first examination
" " " " 196
Steel frame of equipment, connecting pipes, and protective coatings in excellent state
Recommendations:
Next examination should be done when the department stops for repairs, that is, after four months:
Examination carried out:
Senior corrosion engineer . . . . . .
Head of anticorrosion department . . . . . .
Departmental mechanic . . . . . .
Recommendations confirmed:
Chief mechanic of the factory . . . . . .

Second list

Results of second examination. . . . . .
" " " " 196
Frame of apparatus in excellent state. Three tiles have fallen from the first course of the lining on the top cover, apparently owing to vibration. Corrosion damage not detected.
Recommendations: To restore the lining, take measures to reduce vibration of the equipment.
Examination passed:
Senior corrosion engineer. . . . . .
Head of the anticorrosion department. . . . . .
Departmental mechanic . . . . . .
Recommendations confirmed:
Chief mechanic of the factory . . . . . .

Third list

Results of third examination
" " " " 196
Frame of equipment, connecting pipe, and protective coating in satisfactory state. Adjacent equipment underwent serious corrosion as a result of frequent spilling of contact acid from the hydrator.
Recommendations: Increase the height of the hydrator by 1.5-2 mm.
Examination confirmed:
Senior corrosion engineer. . . . . .
Head of anticorrosion department . . . . . .
Departmental mechanic. . . . . .
Recommendations confirmed:
Chief mechanic of the factory . . . . . .

Fourth list

Results of fourth examination
" " " " 196
Hydrator (increased in height) is in satisfactory state. Adjacent apparatus not corroded.
Recommendations: To carry out an examination of the equipment when the department is stopped for capital repairs.
Examination confirmed:
Senior corrosion engineer. . . . . .
Head of the anticorrosion department . . . . . .
Departmental mechanic. . . . . .
Recommendations confirmed:
Chief factory mechanic. . . . . .