TABLE 4. PLANT WATER SUPPLIED EXAMINATION

WATER SUPPLY—	200 feet deep well—average water temperature 53 F—water is producing a brown stain in plumbing fixtures.
SAMPLE—	The sample was scraped from the surface of the shell and tube condenser of #2 Freon Compressor on the meat chilling room. The sterile sample bottle was filled one-half with deposit and the balance with circulating water. No preservative was added—pH at time of collection was 7.4.
ANALYSIS REQUIRED— MACROSCOPIC ☑ MICROSCOPIC ☑ BACTERIOLOGICAL ☑ ORGANIC CONTENT ☑	
PROBLEM—	A 25-ton Freon—12 Compressor has head pressure about 10 lb higher than during initial operation, without change in water temperature. Deposits have been observed on heat exchanger surfaces. It is desired to know the nature of these deposits and if they are the cause of this increased head pressure.
MACROSCOPIC EXAMINATION—	Heavy brown flocculant material settles rapidly in clear water. pH—7.3 Odor—woody, mouldy.
MICROSCOPIC EXAMINATION—	INORGANIC MATERIAL—small amount white crystals. AMORPHOUS MATERIAL—small amount—brown. IRON BACTERIA—profuse growth of crenothrix—(Photo usually included).
CULTURAL EXAMINATION—	SABOURAUD'S AGAR 1. Aerobic gram positive spore-forming rod with mucoid sheaths. (Photo usually included). 2. Short gram negative coccibacilli (Photo usually included).
TOTAL COUNT	100,000 organism/cc.
ORGANIC CONTENT (by WEIGHT, DRY BASIS)—60%	
DISCUSSION—	The presence of common slime-forming organisms in the deposit combined with high organic content indicates that the deposit is bacterial in origin. Heat transfer reductions would be caused by such a deposit. These deposits, combined with crenothrix, can cause corrosion of both ferrous and non-ferrous metals.
RECOMMENDATIONS—	It is recommended that the water be treated at the suction side of the deep well pump with chlorine in quantities sufficient to maintain a free chlorine residual of 1.0 ppm at the discharge of the shell and tube cooler. This treatment can be scheduled on an intermittent basis.

results of such a test are commonly reported in the manner illustrated in Table 4.

Condensates

All condensates result from the chilling of water vapor. Such chilling may result from natural causes, thus producing *dews*, *sweats*, *rain*, and *snow*, or from artificial causes, as in steam condensing equipment, producing condensate or return water.

In the heating and ventilating field, the biological characteristics of condensates are likely to be of concern *only* where the condensate is used as cooling water in recirculating systems. The deleterious gas contents of condensates, however, very often create serious corrosion troubles.

The data in Table 5 typify the chemical composition of the atmosphere in rural and metropolitan areas, and of stack gases when various types of common fuels are used. The curves in Fig. 1 disclose the solubility of the major deleterious gases present in such atmospheres in otherwise pure water, when the partial pressure of the gas is one pound per square inch absolute.

The most common deleterious gases entrained by steam are oxygen and carbon dioxide. In rare instances, hydrogen sulphide, sulphur dioxide, or ammonia are present.

In most steam condensing equipment,[7, 8] the non-condensable gases entrained with steam accumulate so that the amount present in the vapor space is several hundred times higher than in the incoming steam and the amount dissolved in the condensate may therefore approach, or even exceed for short periods, the amount entrained by the steam.

TABLE 5. DATA TYPIFYING THE DELETERIOUS GAS CONTENT OF DIFFERENT ATMOSPHERES

Name of Gas	Chemical Formula	Air				Flue Gases					
		Rural		Metropolitan		Bitum. Coal		Fuel Oils		Natural Gas	
		% by Volume	Partial Pressure psia	% by Volume	Partial Pressure psia	% by Volume	Partial Pressure psia	% by Volume	Partial Pressure psia	% by Volume	Partial Pressure psia
Oxygen	O_2	21	3.143	21	3.143	2	0.299	7	1.048	10	1.497
Carbon Dioxide	CO_2	0.03	0.004	0.06	0.009	15	2.245	13	1.946	10	1.497
Sulphur Dioxide	SO_2	None	None	0.003	0.004	0.07	0.010	0.03	0.004	0.0001	0.0015

CAUSES AND PREVENTION OF SCALES AND SLUDGES

Scales may be formed on surfaces of equipment in contact with water, and sludges in the body of the water, by the separation from the water of dissolved or suspended solids. According to the nature of a particular piece of equipment and the method of its operation, such separation may be promoted by one or more than one, of several factors:

a. The concentration of solids may be increased by the evaporation of water.

b. The dissolved solids may be rendered less soluble in the water by changes in temperature.

c. Conditions may favor the decomposition of unstable compounds with the formation of less soluble compounds.

Figs. 2 and 3 show that the solubilities of both calcium carbonate and calcium sulphate decrease with the rising temperature within a moderate range of temperatures. Surfaces transferring heat into water, such as condensers and coolers, are more susceptible to scale and sludge formation than are the cold parts of the same system using the same water.

The most common of the unstable soluble salts are the bicarbonates of calcium, magnesium, and occasionally iron. Under conditions favoring the removal of carbon dioxide, as when the water is strongly aerated or when it is boiled, the bicarbonates are readily converted to the relatively