Water Analysis and its effect on Polymers

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ABSTRACT:

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water borne diseases. It is therefore necessary to check the water quality at regular interval of time. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates and phosphates. An assessment of the water used in rubber industry can also provide an indication of water quality.

INTRODUCTION

This describes the main industrial processes employed within the rubberproducts manufacturing industry. It specifically contains a description of commonlyused production processes, associated raw materials and possible sources of effluentand emission. Schematic process flow diagrams are suitably depicted to make the descriptions more illustrative.

2.2 BASIC PROCESSES

Rubber product manufacturing is as diverse as the number of rubber products produced. Even with this diversity, several basic common processes are identifiable These common processes are.

Mixing
Milling
Extruding
Calendaring
Building (Fabrication)
Vulcanizing
Finishing

The rubber product manufacturing process begins with the production of a rubber mixfrom raw and / or synthetic rubber, carbon black (the primary filler used in making a rubbermixture), oils and miscellaneous chemicals. Rubber mixture differs depending upon thedesired characteristics of the products being manufactured. Production of the rubbermixture involves weighing and loading of appropriate ingredients into an external / openmixer known as a "Banbury" mixer which is used to combine these ingredients. The areawhere the chemicals are weighed and added to the machine is called the compoundingarea. The ingredients are often introduced into the mixer hopper manually. The mixercreates a homogeneous mass of rubber using two rotors, which shear materials againstthe wall of the machine's body. This mechanical action also adds considerable heat to therubber.The mixed rubber mass is discharged to a mill (rubber sheeting mill) or other pieces ofequipment which forms it into a long strip or sheet. The hot, tacky rubber thus passesthrough water based "anti-tack" solution, dry power, which prevents the rubber sheets from sticking together as they cool to ambient temperature. The rubber sheets are cooledthrough the application of cool air or by contact with cooling water. The process of rubbermixture includes all these steps — Banbury mixing, Milling (or other means of sheeting),Coding and Anti-tack coating.After cooling, the sheets of rubber are passed through another mill. These mills are usedto 'Warm-up" the rubber for further processing on extruders and calendars. Someextruders can be "Cold fed" rubber sheets, making this milling step unnecessary. Extruders transform the rubber into various shapes or profiles by forcing it through dies viaa rotating screw. Extruding heats the rubber and the rubber remains hot until it enters awater bath or spray conveyor where cooling takes place. Calendars receive hot strips ofrubber from mills and squeeze them into reinforcing fibers or cloth-like fiber materials, thusforming thin sheets of rubber coated materials. Calendars are also used to produce non-reinforced, thickness-controlled sheets of rubber.Extruded and calendared rubber components are combined (layer, built-up) with wire,polyester and other reinforcing materials to produce various rubber products. Adhesives, called cements, are sometimes used to enhance the bonding of the various productlayers. This fabrication, reinforcing, pre-curing and bonding process is referred to asbuilding.All rubber products undergo vulcanization (curing). Vulcanization is accomplished inheated compression moulds, steam heated pressure vessels (autoclaves), hot air andmicrowave ovens or various molten and fluidized bed units. During the curing process,the polymer chains in the rubber matrix cross-link to form a final product of durable elastic,thermo set rubber. Increasing the numbers of cross-links in the rubber matrix gives rubberits elastic quality.

In rubber manufacturing factories the water which is used to cool the rubber sheets in the manufacture of tyres is called tread water. The tread water should be highly pure. Any impurities present in it will affect the curing process. Here our aim is to analyze the effect of tread water on polymers. Nearly 88% of water in the rubber manufacturing industries is used for cooling purpose. After usage these water is returned to the source.

Experimental Study

Polymer Preparation:

The polymers used in this study comprises elastomers vulcanizing or cross linking agents accelerators Activators and Retarders, Softeners Plasticizers and fillers, Age resistors and other miscellaneous materials. 5 sets of samples is analyzed and they are

Sample 1:100% of Natural rubber based Insoluble sulphur

Sample 2:100% of styrene Butadiene rubber based soluble Sulphur

Sample 3: 50% Natural Rubber based Insoluble Sulphur and 50% Natural based soluble sulphur

Sample 4: 50% Natural Rubber based soluble Sulphur and 50% SBR based soluble sulphur

Sample 5: 50% Natural Rubber based soluble Sulphur and 50% SBR based Insoluble sulphur

Sample Preparations:

About 50 g of the above samples is taken in 5 different polythene bags and about 2 liters of tread water is added to it.200ml of this tread water is drained from these bags and tested with respect to various parameters like pH, Conductivity, TDS Hardness, Alkalinity, chloride and the results are tabulated in table 1-8.This analysis is carried out for 7 days.

The analysis of the tread water on these samples is discussed.

Particulars	PH	Conductivity	M alkalinity	Total Hardness	Chlorides	TDS
Tread Water	6.42	215	11	22	17.5	142

Table 2

Day: 1

Samples	1	2	3	4	5
PH	6.23	6.44	6.80	6. 60	6.47
Conductivity	200	195	210	205	196
M-Alkalinity	12	20	16	20	24
Total Hardness	24	28	28	28	32
Calcium Hardness	20	24	20	20	24
Chloride	22	31	14	20	25
TDS	132	128.7	138. 6	135.3	129.36

Day: 2

Samples	1	2	3	4	5
PH	5.93	5.72	5. 66	5.70	5.55
Conductivity	201.3	204.3	221.1	201.4	219.8
M-Alkalinity	6	10	8	6	10
Total Hardness	36	34	24	24	14
Calcium Hardness	22	20	18	16	10
Chloride	22	20	22	15	18
TDS	132.85	134.83	145.92	132.92	145

Day: 3

Samples	1	2	3	4	5
PH	5. 68	5.70	5. 60	5. 69	5.50
Conductivity	208.3	206.3	225.3	204.8	225.7
M-Alkalinity	8	10	6	8	12
Total Hardness	26	28	16	26	30
Calcium Hardness	20	22	22	20	18
Chloride	19. 6	23.8	16.8	24.5	22
TDS	137.47	136.15	148.76	135.16	148.96

Day: 4

Samples	1	2	3	4	5
PH	5. 48	5. 68	5. 49	5. 64	5.46
Conductivity	212.4	212.1	229.2	210.7	233. 6
M-Alkalinity	10	12	10	12	12
Total Hardness	28	26	26	26	26
Calcium Hardness	20	25	20	20	20
Chloride	22	22	22.5	18	21
TDS	140.18	139.98	151.27	139.06	154.17

Day: 5

Samples	1	2	3	4	5
PH	5. 44	5. 36	5. 29	5. 62	5.40
Conductivity	235.0	243.2	247.9	220.8	2 63.7
M-Alkalinity	10	14	12	14	14
Total Hardness	28	26	32	30	24
Calcium Hardness	18	20	2 6	20	16
Chloride	28	25	2 6	22	24
TDS	155.1	1 60.51	1 63. 61	145.72	174.04

Day: 6

Samples	1	2	3	4	5
PH	5. 22	5. 28	5. 28	5. 60	5.38
Conductivity	243.2	250.1	252.3	225.9	253.8
M-Alkalinity	20	16	14	18	16
Total Hardness	26	26	32	30	28
Calcium Hardness	18	20	18	16	18
Chloride	28	24	22	21	20
TDS	165.132	168. 69	170.14	151.99	171.665

Day: 7

Samples	1	2	3	4	5
PH	5. 20	5. 24	5. 23	5. 50	5.31
Conductivity	250.2	255. 6	257.8	230.3	2 60.1
M-Alkalinity	20	15	16	20	16
Total Hardness	28	28	34	30	32
Calcium Hardness	18	20	18	18	20
Chloride	29	27	2 6	2 6	24
TDS	165.132	168. 69	170.14	151.99	171.665

<u>Results and Conclusion</u>

According to Robert, the diffusion of water in polymers is complicated by the presence of small amounts of hydrophilic material. This significantly affects the adsorption kinetics and the equilibrium uptake of water in such polymers. The diffusion Co-efficient of water in polymers usually decreases with increasing water concentration.

Water takes considerable time to diffuse into the polymers. Hence, the basic parameters of tread water like Hardness. Alkalinity and chlorides shows no considerable changes. Yet, pH, conductivity and TDS are found to vary slightly on the 7 days analysis.

PH

On day-to-day analysis, the pH value is found to decrease from 6.86 to 5.10. This decrease is due to the increase in acidity of tread water. The increase in acidity is because of blooming of Sulphur. In addition impurities like oxides and amines contribute to it.

This curing process is affected due to the increase in acidity of tread water. Hence, the tread water used for cooling the rubber sheets is changed periodically.

TDS & Conductivity

Total dissolved solids in the tread water is found to increase from 121 to 181 mg/l. This shows that water is slowly diffusing into the polymer samples. This is further proved by the increase in the conductivity values varying from 185 – 275 mho/cm

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