STEEL MILL ROLLER COVERINGS

Overview

Steel is an alloy of iron and carbon and is produced in a multi-stage process. Steel mills turn molten steel into blooms, ingots, slabs and sheet through casting, hot rolling and cold rolling.

Roll covering material selection is essential for performance in the steel industry. Essentially, all steel applications use rubber rollers to perform certain tasks and these rollers are covered with rubber for a specific purpose. Rollers might be rubber covered for frictional properties (i.e. feeding or to provide grip), chemical resistance to protect the metal core from corrosion, to prevent scratching of the steel, release characteristics to prevent sticking, or to convey a paint or coating to the steel surface. Usually steel roller applications involve a combination of many characteristics. For example, a roller application in a nip may require frictional properties to feed the steel, to withstand temperatures in excess of 300°F for intermittent periods, and to resist deterioration by certain chemicals present in the environment.

Each rubber compound has its own set of unique engineering properties that may make it suitable for a particular application. These properties must be matched up with the requirements of the specific application in order to provide the best performance in the process. Unfortunately, there is no rubber compound that will do everything the steel industry requires. As with all roller applications, the rubber compound must be compatible with process requirements at the roller manufacturer's plant as well as being suitable for the given steel mill application.

Rubber compounds are specifically formulated for specific applications. By the proper selection of various compounding ingredients, rubber compounds can be altered to vary hardness, strength and other characteristics, which can provide viable solutions for steel mill applications. Rollers for the steel industry normally must exhibit solvent and chemical resistance, hardness/modulus requirements, as well as having good cut and abrasion resistance. These properties must be constant and not decline in the application.

One of the most interesting aspects to the Steel industry is the variety of roller applications, and the requirements that each demand. There are different types, sizes, operating conditions and functions.

Application & Features

Chemistry

One of the first challenges in steel mill applications relates to the types and numbers of chemicals involved in the steel making process. The steel industry uses a wide range of chemistry to accomplish various functions such as cleaning, pickling, plating, and coating. In these operations, rubber rollers are normally at the center of the process and there is direct contact with the chemistry. To meet service life requirements, rubber compounds must resist the various chemistries such as acids, coatings, solvents and numerous chemicals, and to provide the best solution, one has to have a full understanding of the application. There should be special consideration when blends of chemicals and solvents are used, as some blends are more severe in their attack on rubber than the individual chemicals themselves. If the rubber roller surface is exposed to something, it is important to know what chemical is used, how much is used, is the chemical diluted and if so with what, is the chemistry blended and if so what is the blend. MSDS sheets are always helpful, but they are usually written in general terms and do not give exact percentages and often leave off the key items. Knowing what comes into contact with the roller and at what temperature, is extremely helpful.

Temperature

Most applications in the steel mill operate at temperatures from 160F to 180F, which when combined with the fact most applications also involve chemistry, creates a more severe environment for rubber covered rollers. The severity of the chemical composition on a roll covering sometimes may relate specifically to the temperature of the operating environment. Typically, the higher the temperature the more severe a given solution will effect the composition of a rubber compound. Different elastomers are used for different temperature ranges, thus, if the roller operates at elevated temperatures, it is important to know what that temperature range in the application might be. Some performance requirements to understand are: Is exposure to high temperature intermittent or continuous, and does the roller surface come into direct contact with the heat source. I.e. hot metal strip. Is the actual surface temperature of the rubber as hot as the surrounding environment, and is the roller being cooled internally?

Operating Speed

In today's competitive market, steel operations are always looking for strategic advantages to out-perform competition. Besides cost, the operating speeds of lines are an obvious area where emphasis has been placed. Speed in terms of R.P.M., is important since rollers usually involve a "nip" region, where whatever comes into contact with the rubber creates a distortion in the rubber surface momentarily. As the roller rotates, the rubber is continuously distorted at the point of contact. The faster the roller turns, the more frequent the rubber flexes at the nip point. Since rubber is hysteretic and when compressed, converts mechanical energy into heat, the more a rubber compound is flexed the more heat it will generate, which will cause a reduction in service life. The choice of the rubber compound for the roller covering is critical since the dynamic properties of some elastomers are better than others. For example, NR > BN > XNBR.

Failure Analysis

Understanding the failure mechanism is extremely important in helping to discover solutions for steel applications. One way to begin is to inspect the current roller covering. Some steel mill rollers experience life expectancy of days or weeks due to the specific conditions, but others may last for years. By asking "How did the roller fail?", and understanding the cause could lead to a better selection of rubber covering.

Steel Mill Roller Coverings

Recommended Compounds For Steel Mill Roll Positions:

ANVIL ROLLS	AF, SAF
BRIDLE ROLLS	AF, SAF, XNP, 38XN, 61BN
DEFLECTOR ROLLS	HYS,NEX,51HY
HOLD DOWN ROLLS	HYS,NEX, 51HY
SNUBBER ROLLS	BNX
SQUEEGEE ROLLS	HYS, NEX,51HY
STEERING ROLLS	AF,XNP, 38XN
HOT WATER WRINGER ROLLS	AF, HYS

Excel Polymers Product Offering

Compound	Benefits
AF	45-95 Duro. Black-Filled Nitrile. Good in aggressive hot aqueous media. Outstanding hardness stability, abrasion resistance, & resiliency.
SAF	60-80 Duro. Black-Filled Nitrile. Excellent physicals & abrasion resistance.
BN 61 Series	40-95 Duro. Nitrile. Exceptional abrasion resistance.
BNX	40-90 Duro. Specially formulated high CAN Nitrile for enhanced chemical resistance to aromatic solvents.
HY 51 Series	40-95 Duro. Hypalon. Exceptional wear & cut resistance, with outstanding load bearing & temperature resistance.
HYS	60-90 Duro. Commodity, Black-Filled, Blended Hypalon compound.
NEX	65-90 Duro. Black-Filled Neoprene. Good balance of chemical properties and chemical resistance.
SBR	60-90 Duro. Copolymer of Butadiene & Styrene. All purpose compound.
XN 38 Series	75-95 Durometer. Non-black, anti-static XNBR. Excellent abrasion resistance, with low heat build-up.
XNP	60-90 Duro. Highly reinforced Carboxylated Nitrile. Compound offers improvement over standard XN Series.

Largest Steel-Producing Companies Worldwide

1. 117.2—Arcelor Mittal (Global)
2. 32.0—Nippon Steel (Japan)
3. 30.5—POSCO (South Korea)
4. 29.9—JFE (Japan)
5. 28.2—Tata Steel (India)
6. 23.8—Baosteel Grp Corp. (China)
7. 19.3—U.S. Steel Corp. (USA)
8. 18.4—Nucor Corp (USA)
9. 17.5—Riva Group (Italy)
10. 16.8—Techint (Argentina)
11. 16.5—ThyssenKrupp (Germany)
12. 16.1—Tangshan (China)
13. 14.6—Shagang Group (China)
14. 13.9—EvrazHolding (Russia)
15. 13.7—Gerdau (Brazil)
16. 13.6—Severstal (Russia)
17. 13.5—Sumitomo Metal Ind. (Japan)
18. 13.4—Steel Auth. Of India (India
19. 12.0—Wuhan Iron & Steel (China)
20. 11.9—Anshan (China)
21. 11.4—Magnitogorsk (Russia)
22. 10.5—Shougang (China)
23. 10.4—Jinan (China)
24. 10.3—Laiwu Steel (China)
25. 10.3—China Steel (Taiwan)
26. 9.6—Maanshan (China)
27. 9.4—Imidro (Iran)
28. 8.7—Usiminas (Brazil)
29. 8.5—Novolipetsk (Russia)

****Output in Million Metric Tons Crude Steel**

*****List According to the International Iron and Steel Institute July 2006**

Steel Mill Compounds
Test Data

Compounds :	NEX70 X1	NES70 0 1	HYB70 0 1	HYS70 0 1	HY70 0 1	AF70 2 1	SAF70 0 1	PXN70X1	CUX70 9 6	XNP70 0 1	BNX70 2 1	NEX8 0 2 1
Date: 4 /4 /07												
Hardness on Button	72	66	72	68	66	69	75	64	72	72	72	75
Hard nes s on roller	73	67	74	73	74	70	77	78	72	75	73	78
Min Torque	1.75	1.55	0.30	0.46	1.04	1.11	1.99	0.71	0.65	0.28	1.46	1.35
Max Torque 2	8.45	15.13	18.38	15.72	21.54	32.18	34.60	12.95	21.94	18.04	42.28	17.86
T2	0.69	2.25	1.89	1.90	2.14	0.75	1.20	2.54	3.02	2.35	0.57	0.65
T90	7.76	7.99	7.98	7.06	7.28	8 .11	4.61	5.40	5.65	5.63	7.58	8.02
Mooney Viscosity												
M(1+4)	37	37	14	20	32	28	42	25	25	13	37	33
Tensile, PSI	1888	1543	1953	1370	2142	1528	2251	2439	2635	2332	1260	1055
% Elongation	188	358	423	369	578	219	280	595	388	376	261	177
100 % Modulus	838	385	526	366	407	678	626	259	476	461	452	662
200 % Modulus	-	802	924	675	646	1424	1580	545	1030	1030	878	
300 % Modulus	-	1289	1297	1127	839	-	-	924	1788	1737	-	
Tear, PLI	98	136	157	124	207	96	177	191	174	155	102	103
% Perm. Set	6	18	40	20	50	4	10	20	11	10	10	15
% Comp. Set	14	28	41	47	64	10	18	33	25	17	13	23
Resilience	33	20	15	10	28	33	18	16	26	28	18	26
Abrasion												
SPECIFIC GRAVITY	1.29	1.44	1.30	1.39	1.34	1.35	1.20	1.14	1.15	1.15	1.30	1.29
10 % N aOH												
% AVG VOL SWELL	3.59	2 .70	14.48	4 .04	34 .9	-3 .50	-0 .07	20.17	27.01	25.52	5.40	1.07
% AVG WT LOSS	-1.80	0 .74	-0.05	-0.11	-2.66	-6.15	-7.75	-2 .86	-17.53	-20.38	-8.50	0.24
SWELL HC	-1	-3	-15	-1	-24	-2	-3	-4	-38	-41	-19	-1
DRIED HC	4	5	-3	8	0	4	6	21	-16	-10	1	1
10 % HCL ACID												
% AVG VOL SWELL	3.47	18.2	24.24	0.72	25.59	6.48	3.95	6.78	9.56	11.23	13.13	3.84
% AVG WT LOSS	-0.70	1.67	-0.86	-0 .87	2.08	0 .49	-0.04	0.33	-0.19	-0.26	-0.34	0.5
SWELL HC	-1	-7	-5	3	-17	-2	0	10	-3	-1	-9	-3
DRIED HC	2	1	5	6	-10	2	4	16	4	5	4	1
10% SULFURIC ACID												
% AVG VOL SWELL	3.91	11.44	1.79	0.00	26.32	3.36	4.30	7.16	6.80	11.20	29.42	
% AVG WT LOSS	-0.22	0.86	-0.98	-0.97	2.53	0.43	-0.09	0.95	0.16	0.33	2.95	
SWELL HC	-1	-5	-5	4	-9	-2	-2	11	-3	-3	-14	
DRIED HC	1	3	5	6	-7	0	3	17	6	7	1	
10% CROMIC ACID												
% AVG VOL SWELL	9.16	21.49	6 .05	3 .73	24.76	8.17	15.44	6 .55	10.3	14.14	19 .71	
% AVG WT LOSS	1.43	5.23	1.61	0.78	3.34	2.29	3.81	1.01	0.97	0.73	5.60	
SWELL HC	0	-4	-3	4	3	-3	-1	14	0	2	-1	
DRIED HC	4	3	3	6	12	0	2	19	7	9	-4	
10% NITRIC ACID												
% AVG VOL SWELL	11.22	12.11	6.83	1.83	6.04	39.37	27.03	71.28	11.94	50.15	15.8	11.19
% AVG WT LOSS	1.45	0 .99	-0.26	-0.57	-5.23	1.3	0 .43	1.94	-1.92	1.83	0.63	2 .13
SWELL HC	1	-3	-6	1	-4	-6	-1	-2	-9	-12	-2	-6
DRIED HC	2	4	3	3	5	-5	4	2	3	-4	6	-1
10% HF ACID												
% AVG VOL SWELL	5.54	9 .63	12.67	1.95	17.57	54.75	12 .35	17.37	20.77	31.79	31.59	10.44
% AVG WT LOSS	0.25	2.94	-0.03	-0.46	3.44	3.98	1.56	2.86	2.31	3.73	4.41	1.71
SWELL HC	-3	-3	-9	-2	0	-14	-4	-1	-13	-17	-12	-10
DRIED HC	0	5	5	2	9	3	4	10	0	-6	7	-2
2 % HF / 8 % NITRIC												
% AVG VOL SWELL	10.2	11.21	12.79	3.88	16.84	39.35	27.99	56.41	49.11	75.11	38.45	16.6
% AVG WT LOSS	1.74	0 .79	-0.30	0.03	3.46	2 .04	2 .92	3.49	4.46	8.17	9.32	2.43
SWELL HC	-1	-3	-7	0	1	-6	-5	-1	-12	-15	-8	-7
DRIED HC	0	5	1	4	8	4	-2	9	0	-10	-5	-1

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