

## **The Performance of Raw Rubber Dried Using Different Drying Systems**

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### **Introduction**

Drying and smoking are two operations carried out simultaneously during the manufacture of smoked sheet rubber. Smoke acts as the carrier medium for heat and the chemical substances presence in the smoke. Heat removes the moisture presence in the sheets which is approximately amounts to 30% (wb). Some of the chemical substances with antioxidant and antimicrobial properties available in the smoke deposit on the sheet rubber and enhance their resistance to oxidation and mould growth. Ribbed smoked sheets which are the major contributor for local rubber production, are conventionally dried for 4-5 days at 48 -54 °C in a smoke house with intermittent interruptions of drying for the purpose loading unloading of sheets. Recently introduced single day smoke drying system (SS drying system) dries wet sheets continuously at a rather higher temperature of 55 – 65 °C. In this system, wet sheets are exposed to hot smoke at a higher drying temperature, however, for a shorter period. Sheets are also dried in open sun without control and in a stream of warm air (34 °C) for about 6-8 days to produce smoke free sheet rubber. Therefore, according to drying system used, sheet rubbers may be categorized as; Conventionally Smoke Dried sheets (CSD), Sun Dried Sheets (SDS), Air Dried Sheets (ADS) and Single day Smoke dried sheets (SS). Different drying systems may vary the quantity of smoke adsorbed to the surface of the sheets and duration and temperature to which sheets are exposed to. Consequently, the sheets dried using different drying systems may have different degree of resistance to the oxidation and fungal attack affecting the raw rubber and rubber vulcanizate properties. This study therefore, attempts to study the raw rubber and rubber vulcanizate properties of the sheet rubber dried using selected four drying systems.

### **Methodology**

Wet sheet rubber samples were prepared using standard sheet rubber manufacturing procedures. They were dried using four drying systems namely; single day smoked drying (SD1), three day smoked drying (SD3), five day smoked drying (SD5) and hot air drying (ADS). Raw rubber properties and rubber vulcanizate properties (ageing and un-ageing) were tested. The FTIR spectrums of raw rubber samples were obtained in an attempt to identify organic materials presence on them. Acetone extractions test was also performed on each sample to measure the smoke content. Mould growths of the samples were examined under 100% humidity conditions and under ambient conditions (28 °C, 80% humidity).

## Results and discussion

Raw rubber properties of the sheet rubber produced at different conditions and their vulcanizates properties are presented in Tables 1 and 2, respectively.

Table 1: Raw rubber properties of sheet rubber

Type of sheets	Wallace plasticity number (P <sub>0</sub> ) [min. 30]	Plasticity retention Index (PRI) [min. 60]	% (W/W) Volatile Matter (VM) [max.0.80]	Dirt (% w/w) [max. 0.05]	Ash (% w/w) [max. 0.40]
SD1	49	89	0.69	0.041	0.35
SD3	51	82	0.72	0.038	0.34
SD5	48	83	0.60	0.052	0.36
ADS	45	97	0.88	0.032	0.42

- [ ] accepted standards

It can be seen that overall raw rubber properties of the samples dried in different drying systems have not seen any significant difference. All the raw rubber properties tested lie within the accepted standard ranges agreed for natural rubber. However, VM of the air dried sheet which was dried at a lower temperature has shown a higher value than the accepted maximum value. All smoked and dried sheets show lower PRI values (resistance to oxidation) than the ADS rubber which was not exposed to smoke. Smoked sheets were dried at higher temperatures and they might have been subjected to a thermal oxidation to a certain extent than the ADS, making PRI values of former are low. However, smoke should provide a resistance to the sheet rubber as reported in the literature. Therefore, the highest PRI value registered for ADS should be further investigated.

Table 2: Vulcanised properties of rubber sheets dried at different drying conditions

Sample	Tensile strength		Elong. @ break		Hardness	Compression set (%)	Abrasion weight loss % (wt)
	unaged	aged	unaged	aged			
SD1	19.35	21.06	675	575	43	7.39	7.07
SD3	18.06	22.02	760	720	45	7.49	6.5
SD5	23.98	23.60	740	700	49	7.28	5.5
SD4	23.28	17.08	640	600	47	6.53	6.5

Comparison of physical and mechanical properties of the vulcanizate shows that variation of the properties (except for abrasion loss) has not been affected at any appreciable level. The lowest abrasion weight loss level of SD5 sample suggests that smoking for five days has a notable effect on the resistance to oxidation at high temperature even though it was not reflected when oxidation is taken place at low temperature as indicated by the PRI values of smoked rubber. Tensile drop of the ADS sample after ageing again confirms the resistance offered by smoke to the smoked sheets for high temperature oxidation.

Studies carried out on the resistance to mould growth on sheet rubber clearly show that the duration of smoking has a clear improvement in offering resistance to mould growth at

100% humidity. However, there is no any appreciable effect of smoking on the same at ambient conditions (RH 80%). FTIR analysis and acetone attraction experiments did not yield any good results to identify the effect of smoking on their performance.

### **Conclusions**

It can be seen that smoking at deferent levels has no significant effect on the raw rubber properties. However, exposure to high heat level tends to lower the PRI values. Mechanical properties of the samples do not show any significant adverse effect other than for abrasion weight loss.

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