Advances In Rubber Cultivation and Processing

Abdul Aziz S.A. Kadir
Lembaga Getah Malaysia

Abstract

Current annual natural rubber (NR) production in Malaysia have stabilised to about the 1 million tonnes level, down from the peak of about 1.5 million tonnes in the early to mid-nineties. The reasons for the decline have been attributed mainly to labour shortage and the conversion of rubber land to more lucrative crops and to infrastructural, industrial and residential developments. The rubber industry, although gradually losing its glitter due to price vagaries, still stood the test of time because about 400,000 smallholder families are still dependent on the crop as a means of income and the rubber-based manufacturing industries need this important raw material. Furthermore, some areas are only suitable for growing rubber. There has been a significant rise in local consumption of NR particularly in the latex dipped industry making Malaysia one of the major rubber products manufacturers in the world outside of USA and EU markets.

The advances in rubber cultivation and processing attained by the Malaysian rubber industry owed a great deal to the R&D exploits of the Rubber Research Institute of Malaysia (RRIM). Significant breakthroughs in research resulted in new technologies spawned over the years to develop the upstream, processing and downstream sectors. Some advances in rubber cultivation and processing are described in this paper.

1.0 Advances In Rubber Cultivation

Breeding and Selection of New Clones

The main thrust of advances in rubber cultivation has been in the breeding and selection of new clones with high latex productivity. Through concerted and consistent efforts in breeding and selection new clones have continuously been produced for the rubber industry in Malaysia. In fact over the last couple of decades the yield productivity has been increased six fold i.e. from 500 kg/ha/yr from unselected seedlings in the 1920’s to yields of 3000 kg/ha/yr for currently recommended RRIM 900 and RRIM 2000 series clones. This phenomenal increase in yield productivity is all the more spectacular, given the narrow genetic base of the limited number of Hevea seedlings brought into Malaysia at the turn of the century. The yield profiles of some of the most promising modern clones are given in Table 1.

The rubber tree has in recent times gained added significance as a dual purpose economic crop in view of the increasing use of rubberwood for manufacture of downstream furniture products. This has meant a shift in emphasis in the breeding and selection programme to produce clones with both high latex and timber productivity or latex timber clones. With this re-emphasis, several promising latex timber clones have been produced for planting by the rubber industry. The timber potential of these clones has been increased from 0.4 cubic meters of a popularly and widely planted clone viz. RRIM 600 to potential of one cubic meters for several RRIM 2000 series clones (Table 2).

In attempts to broaden the genetic base and further push up the latex and timber productivity, new germplasm collected from the Amazon in Brazil through expeditions carried out in 1981 and 1995, have been brought into Malaysia and planted at designated sites. The promising materials are being used in the on-going breeding programme and are expected over a couple of generations to produce clones with very high yields of latex and timber. In parallel with these new approaches, efforts are also being made to markedly reduce the time frame involved in production of new clones. Several modifications have been incorporated in the production and selection cycle to enable the period to be reduced from 25-30 years to a period of 15 years. This reduction in period for
Table 1: Mean Yield in Kg/Ha/Year of RRIM 900 Series and RRIM 2000 Latex Timber Clones*

<table>
<thead>
<tr>
<th>Clone</th>
<th>Parentage</th>
<th>Year of Tapping</th>
<th>Mean</th>
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<tr>
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<td>RRIM 2001</td>
<td>RRIM 600 x PB 260</td>
<td>1695</td>
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<tr>
<td>RRIM 2015</td>
<td>PB 5/51 x IAN 873</td>
<td>2506</td>
<td>2234</td>
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<tr>
<td>RRIM 2008</td>
<td>RRIM 623 x PB 252</td>
<td>1512</td>
<td>2321</td>
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<tr>
<td>RRIM 2016</td>
<td>PB 5/51 x IAN 873</td>
<td>2173</td>
<td>2499</td>
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<tr>
<td>RRIM 2002</td>
<td>PB 5/51 x FORD 351</td>
<td>1455</td>
<td>2152</td>
</tr>
<tr>
<td>RRIM 2009</td>
<td>GT 1 x PB 260</td>
<td>1887</td>
<td>1852</td>
</tr>
<tr>
<td>RRIM 2020</td>
<td>RRIM 5/51 x IAN 873</td>
<td>1691</td>
<td>1860</td>
</tr>
<tr>
<td>RRIM 2014</td>
<td>RRIM 717 x PR 261</td>
<td>1063</td>
<td>1839</td>
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<tr>
<td>RRIM 2023</td>
<td>IAN 873 x PB 260</td>
<td>1989</td>
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<td>RRIM 2024</td>
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<td>RRIM 2025</td>
<td>IAN 873 x RRIM 803</td>
<td>1921</td>
<td>2915</td>
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<tr>
<td>RRIM 2026</td>
<td>PBIG GG 4/5</td>
<td>1450</td>
<td>2075</td>
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</table>

Tapping system: ½S d/3 6 d/7

*Extrapolated yield from Small Scale Clone Trial

Table 2: Estimated Wood Volume for Group II Latex Timber Clones

<table>
<thead>
<tr>
<th>Clone</th>
<th>Parentage</th>
<th>Age (Year)</th>
<th>Clear Bole Volume (m³/tree)</th>
<th>Canopy Wood Volume (m³/tree)</th>
<th>Total Wood Volume (m³/tree)</th>
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<tr>
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<tr>
<td>RRIM 2009</td>
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<td>0.43</td>
<td>0.87</td>
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<td>RRIM 2016</td>
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<td>0.43</td>
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<td>0.35</td>
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<td>RRIM 2024</td>
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<td>0.52</td>
<td>0.74</td>
<td>1.26</td>
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<tr>
<td>RRIM 2025</td>
<td>IAN 873 x RRIM 803</td>
<td>14</td>
<td>0.63</td>
<td>1.20</td>
<td>1.87</td>
</tr>
<tr>
<td>RRIM 2026</td>
<td>PBIG GG 4/5</td>
<td>14</td>
<td>0.66</td>
<td>0.45</td>
<td>1.11</td>
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</table>

*Extrapolated yield from SSCT
recommendation of new promising clones will benefit greatly the rubber growers since they will continuously have a broad choice of clones with upward trend in yield and timber potentials. It is expected that in the not too distant future with broadening of the genetic base with infusion of new germplasm, there will be clones with yield potentials above 4000 kg/ha/yr and timber potentials of more than two cubic meters per tree.

**Horticultural Practices**

There have been marked improvements with regard to Horticultural practices associated with rubber cultivation. The most significant development has been the young budding technique which enables production of quality planting materials at much reduced prices, with very high transplanting success and lower planting or replanting costs. The production of two whorl polybag plants using this technique allows for increased production to cater for replanting of large hectarages without imposing a strain on the available resources. During the last couple of years, the supply of high quality planting materials to smallholders has enabled their plantings to achieve maturity much earlier with better uniformity in growth of trees and a high stand at time of opening for tapping.

**Land Preparation Methods**

The zero burning technique has been developed as an environment-friendly land preparation method for rubber replanting. With this method, the marketable rubberwood logs are initially removed and the plant remnants in gently undulating to flat terrain, are stacked in alternate interrows of 7 to 8 meters as opposed to 5.5 meters in conventional interrows. For sloping to hilly terrain the plant remnants are generally displaced downhill and often heaped on old terraces, with the aid of a bulldozer. The normal operations of ploughing, legume planting, holing and planting of rubber are carried out after zero burn operations are completed. The zero burning technique besides being environment friendly, preserve soil organic matter and recycle nutrients locked in the woody materials, back to the soil.

**Reduction of Field Immaturity Period**

The uneconomic and unproductive immature phase of rubber covering periods of 5 to 7 years has been a major disadvantage associated with rubber cultivation. The reduction of this protracted immature period has been the focus of intensive research activities over the last couple of years. Advanced planting materials consisting either of 5 to 6 whorl plants in large polybags or maxi stumped budings or core stumped budings have been developed through refinements in horticultural techniques and nursery practices. These materials refer to plants that are raised and nurtured intensively in the nursery and later transplanted in the field at an advanced stage. These advanced planting materials raised in the nursery for 9 to 18 months have been used together with appropriate agronomic practices to successfully reduce the field immaturity period to 4-4½ years, with trees being opened for tapping at forty cm girth sizes. Further efforts are being made to reduce the immaturity period to 3 to 3½ years and this is likely to be attained with use of very vigorous and fast growing RRIM 2000 Series Clones. These clones have recorded impressive growth rates when compared to RIM 900 series clones or promising PB 300 Series Clones, when planted in the conventional way without use of advanced planting materials. The reduction of the immature phase to 3 years will enhance markedly the economic viability of rubber as a plantation crop, enable early returns on investment and reduce the period for recovery of initial planting and immature phase upkeep and maintenance costs.

**Management of Diseases and Weeds**

Several cost effective and environment friendly methods have been developed to successfully manage diseases affecting rubber trees and for weed management under immature rubber. Corynespora leaf fall, a serious disease affecting rubber can be reduced with 4 to 6 weekly spraying of fungicides (benomyl or hexaconazole) at the time of refoliation. Since Corynespora leaf fall often occurs together with secondary leaf fall, a disease caused by either *Oidum heveae* or *Colletotrichum gloeosporioides*, alternate spraying of propiconazole with benomyl has enabled
simultaneous control of these diseases. Less laborious and economical methods which use less chemical have been developed to control pink disease, which is a stem disease caused by *Corticium salmonicolor*. These methods involve fungicide spraying using a controlled droplet applicator (CDA) or by pasting sponge impregnated with fungicide, onto the disease lesions.

Weed control constitutes about 17% of the cost of rubber replanting as regular weeding is required especially within the initial four years of rubber planting. Previously the most common method of weeding was by manual slashing or application of paraquat, paraquat mixtures or more recently glufosinate ammonium (Basta 15). The drawbacks with these chemicals are either high mammalian toxicity or high cost. For grass weeds, glyphosate is most cost effective. Glyphosate mixed with broadleaved herbicides such as metsulfruron methyl or 2,4-D isopropylamine are most cost effective to manage mixed weeds. These mixtures increase the weed spectrum killed and duration of control. With these mixtures, the weeding rounds have been reduced from 22 to 11 rounds within the first three years after planting. This is an important development to save cost as labor constitutes about 60% of the total cost of weeding.

**Rubber Based Agroforestry**

With the increasing significance of rubber as a dual purpose economic crop, rubber forests have been established for purposes of timber extraction. It has also been identified as an important timber species for compensatory planting in logged over areas. Research studies are in progress in established rubber forest plantings to evaluate suitability of various cultivars in terms of growth and timber potentials, cost effective methods for weed management and select appropriate low labour intensive and economical agronomic practices. Several economic models will be tested in these rubber forest plantings. These models involve a fifteen year cycle, with trees grown either for 8 or 10 years, with later extraction thereafter for 7 or 5 years before trees are cut down at 15 years of age for timber extraction. The economic viability of these two approaches will be compared with trees grown for 15 years before being harvested exclusively for timber without recourse to latex extraction.

High density planting has been developed as an approach for increasing both latex and rubberwood production. In contrast to the conventional density of 450 trees/ha, densities ranging from 600 to 2000 trees per hectare have been evaluated and found to be feasible. In a trial planting of 2200 trees per hectare with clone PB 260, the average bole height at the end of 10 ½ years was 8.1 m, while the bole volume was 0.15 m³ per tree yielding potentially 368 m³ per hectare of wood volume. It is expected that with use of the more vigorous RRIM 2000 series clones, the wood volume will be much higher than that recorded with older clones. Higher densities of planting are now being recommended both in traditional plantings and in rubber forest plantings.

**Maximization of Land Productivity with Rubber Based Integrated Farming System**

The system of planting for rubber can be modified to accommodate integration of other economic crops. Thus rubber can be planted as an hedgerow system either as single, double or triple hedge rows at densities of 400 to 480 trees per ha, thus creating wide interrows of 18m, 22m and 25 meters respectively. The land area available for integration of other crops and cash cropping ranges from 74 to 88%. Rubber has successfully been integrated with perennial fruit trees, industrial crops such as cocoa and manau rattan. Data from an area with rubber and cocoa planting show that rubber yields are not adversely affected, with yields ranging from 1750 to 2210 kg/ha/yr. Cocoa generated yields of 645 to 825 kg/ha and it is envisaged that a cumulative gross revenue of RM6800/ha/yr can be obtained from such an integrated system. Studies have also shown that incomes of more than RM4000.00 can be obtained from interrow harvesting of various cash crops (viz. chillies, watermelon, bananas) during the first three years after field planting.

Cropping systems that reduce the environmental hazards during the process of land preparation and planting have successfully been developed. Contour planting of pineapple hedgerows
combined with continuous maize and groundnut reduces soil erosion tremendously and are economically beneficial to the smallholders. These improved intercropping systems effectively reduced soil loss to tolerable levels of 3 to 7 tonnes per hectare, while soil loss from rubber without vegetative ground cover was 122 tonnes per hectare.

The future direction is towards integration of other economic and fast growing timber species such as Sentang, Jati and Khaya with rubber, to value add to the rubber smallholders’ land and increase the economic viability of the smallholding. Integration of other timber species with rubber will also obviate the need to source for new land given its increasing scarcity. In addition medicinal plants of economic importance will be integrated with rubber to value add to the land and to meet the increasing demand for naturally derived pharmaceuticals.

**Exploitation Systems**

Rapid strides have been made in the development of new exploitation systems to tackle increasing problem of labour shortage, rising costs of production and low levels of profitability in rubber smallholdings or estates. Low Intensity Tapping Systems (LITS) were developed to address and overcome the critical constraints currently faced by the industry. LITS basically consists of three technologies namely the LIT d/6, RRIMFLOW (RF) and REACTORRIM Systems (RR). The LIT d/6 system which is a modified conventional system involves tapping of a half-spiral tapping cut with reduced frequency of once a week tapping (d/6) in combination with ethephon stimulation. RRIMFLOW system involves tapping of a one-eighth short-cut on reduced frequency of d/4 (once in 4 days) in combination with intermittent gassing of the bark tissues once in ten days. REACTORRIM system involves tapping of a one eight short-cut on reduced frequency of d/4 in combination with continuous but slow release of gaseous stimulant into the bark tissues.

The LIT d/6 system which is presently recommended for young mature trees below 15 years of age can increase tapper productivity to 45 to 65 kg per tapping which is two to three fold above that obtained from conventional d/2 or d/3 systems. This in turn boosts the income of tappers well above that earned by tappers in normal tasks. It is also an attractive system for smallholders with uneconomic sized holdings, since with once a week tapping of his holding, the smallholder has flexibility in tapping other smallholdings which have been abandoned or in sourcing income from other economic activities. The reduced land productivity of 20% when compared to more frequent tapping systems is currently being addressed by combining with either enlarged task sizes of 650 to 750 trees per task or by adopting high density plantings of 600 trees per hectare in combination with LIT d/6 system. This combination will allow for a reasonable increase in tapper productivity while ensuring that the land productivity is attractive enough for achieving the required profitability per hectare.

The novel LIT Systems of RRIMFLOW and REACTORRIM currently recommended for trees 15 years of age and above have been shown to increase tree productivity to 70 to 140 g/t/t resulting in enhanced tapper productivity of 65 to 80 kg per tapping. Land productivity with these systems have on a broad spectrum of clones, ranged from 1300 to 3600 kg/ha/year for periods of 3 to 4 years or 30 to 100% above that obtained from trees tapped on conventional systems. The income of tappers and smallholders using these systems have increased to levels of RM1000 to RM2000 per month and the profitability per hectare have also been higher than that obtained from conventional systems. Economics analysis of an owner operated smallholding which has adopted the RRIMFLOW system shows that the benefit/cost ratio is 7.5, while the pay back period for investment on materials used for the system is 12 to 14 tappings or one to two months.

**Mechanisation in Manuring, Tapping and Collection**

The manuring of rubber is an intensive operation requiring 21 rounds during the initial years after planting and thereafter annual applications of ½ to 1 kg per tree when trees are mature. Manual operation in a rubber estate requires 8 to 10 workers to carry and broadcast heavy load of fertilizers. A mechanical fertiliser spreader mounted on a 20 hp tractor has been developed
by modification of commercially available spreaders. The changes were made to the delivery system by redesigning the rotor blade as well as altering the size of the apertures on the spreader so that the low rates of fertilisers applied during the immature phase can be carried out. Mechanical application using the spreader involves broadcasting of fertilisers in a straight band on one side of the tree rows. This method can also be used for manuring of leguminous cover crops. The findings from use of the mechanical spreader are that for leguminous cover crops, the application was four times faster than manual operation, while for rubber the labour requirement was reduced from 8 to 10 workers to only two workers. Mechanization on a large scale is practicable on gentle terrain to sloping land forms. On slopes of 1\(^{0}\) and 2-16\(^{0}\), manuring was expedited by 2 to 6 times respectively. The future is to develop lightweight tractors with greater power to be able to manoeuvre over rough surfaces due to presence of gullies, raised lateral roots and fallen tree branches. To facilitate mechanization, studies are in progress on sizes of terraces to be used for planting and it has been established that 5.5 meters width terraces, which is accessible for tractor movement, enables faster planting of rubber, with mechanized manuring being thrice as fast as that on conventional terraces. Thus for gently undulating terrain a broad terrace is recommended to facilitate mechanization.

Tapping, stimulation and crop collection are labour intensive operations and constitute 60% of the total production costs. The progress on mechanization or automation of tapping has not been very promising despite heavy financial commitments and intensive research efforts over the last couple of years. However progress is being made with regard to mechanization of infield crop collection. A simple prototype, named as LANCA-GM cart has been fabricated to facilitate infield crop collection, with a load capacity of 100 kg. The cart which can be pushed or pulled, can be attached to a motor-cycle. Field assessment has shown that the collection time can be reduced with more importantly the physical fatigue normally experienced by the tapper being overcome. With use of this simple device it is hoped that the tapper productivity can be enhanced with consequently reduction in costs of production.

**Value adding to the rubber tree – production of foreign proteins by transgenic rubber tree**

Besides planting *Hevea* for its conventional rubber crop, the rubber tree can also be genetically engineered for novel applications. The rubber tree produces voluminous latex which can be extracted non-destructively through the process of tapping. By transforming *Hevea* with genes that control the production of high-value proteins (e.g. pharmaceuticals), transgenic rubber plants could serve as efficient, low cost, low maintenance and environment-friendly production lines for the production of the targeted protein. The system would enable continual harvesting of the protein exuded in the latex that is free of bacteria and animal viruses.

Through the technique of co-cultivation with *Agrobacterium*, *Hevea* callus tissue has been successfully transformed with the genes encoding kanamycin resistance, the enzyme β-glucuronidase (GUS) and an antibody fragment. The *gus* gene is expressed in the leaf of the transgenic plant and, crucially, also in the latex obtained from the transgenic plant regenerated through *in vitro* culture. In fact, GUS expression is especially enhanced in the latex within latex vessels. The expressed GUS protein is found in the aqueous latex serum which can be efficiently recovered by centrifugation. As *Hevea* is amenable to vegetative propagation, large numbers of genetically identical plants can be multiplied from a single selected transformant. Expression of the GUS protein has been demonstrated in three vegetative generations of transgenic *Hevea*.

**Future of Rubber Cultivation**

Rubber smallholders will be the major producer of NR in the future comprising about 80 percent of cultivators. Compared to our neighbouring low-cost producers in Thailand and Indonesia, Malaysia is high cost producer of rubber. The low rubber price, locally as well as on the international market, stifles the interest of smallholders to optimise land and labour productivity. Coupled to this situation, the replanting rate has slowed down considerably and this will has a significant impact on the future production of rubber in the country. The old rubber stands need to be rejuvenated with
new high yielding latex timber clones wherein new technologies can be injected. New technologies in exploitation and farming systems are not readily accepted if the current price trend prevails. Mechanisation and automation in the cultivation and cultural practices are not very practical when returns from its cultivation are not remunerative enough. However, Malaysia needs to sustain its rubber cultivation to feed the rubber based manufacturing and furniture industries apart from assuring the socio-economic existence of future rubber smallholders.

2.0 Advances In Rubber Processing

The target as envisaged by various policies such as IMP1 and IMP2 is for the Malaysian rubber industry to strengthen the value-added chain and eventually consume the bulk of its NR production. The RRIM continually carries out R&D in NR processing that are vital to enhance competitiveness of Malaysian NR vis-à-vis other NR producers. The areas targeted are cost reduction, improving efficiency and providing new advanced forms of NR tailor-made for consumer requirement. This will ensure that ultimately Malaysia becomes a major player in the global NR market.

Process Flow for NR

Advances in natural rubber (NR) processing in this country have been influenced mainly by demand-pull factors in the market place. With the advent of Standard Malaysian Rubber (SMR) in the mid-1960’s, production of conventional NR grades such as ribbed smoked sheets (RSS) quickly gave way to block rubber for several reasons. Consumers wanted NR that was technically specified (TSR) according to parameters which reflected their inherent quality rather than the more subjective visual grading which was the norm for classification of the conventional grades of NR. In addition, the packaging of SMR in uniform-sized bales wrapped in polythene bags and packed in standard sized crates permitted a more efficient method of shipment as well as storage at both producer and consumer factories. Consumer acceptance of Malaysian SMR as reflected in current statistics show almost 100% of dry NR consumption is in the form of technically specified rubber. Other major NR producers like Thailand and Indonesia are attempting to repeat this success by switching over an increasingly greater proportion of their NR production from conventional to technically specified rubber. The general flow-chart for NR processing is given below:
General Purpose Grades of NR

Latex from a rubber tree is converted into premium products like latex concentrate, SMRL, and SMR CV. Latex concentrate is used in dipped goods manufacture such as in gloves, condoms, catheters etc. The cost savings in latex transport coupled with availability of skilled manpower were major reasons for the dipped goods industry to relocate their plants from the West to Malaysia, making us the world’s largest producer in this sector since the mid-eighties.

Up to 70% of NR is consumed by the tyre industry using mainly grades originating in field-grade material. These field-grade material (cuplumps, treelace, field coagula) are processed into SMR10 and SMR20.

Specialty Grades of NR

Whilst Malaysia continues to maintain a high standard of production in its general purpose grades, the need to produce grades tailor-made to suit specific consumer needs is being recognised. One major area of thrust in the recently formulated Revised Rubber Strategy (RRS) of the Malaysian Rubber Board is the increased production and marketing of such specialty rubber. Unlike general purpose grades, processing of specialty rubber involves significant R&D efforts to determine factors such as alternative stabilisers, effective chemical and/or physical treatment of raw rubber, non-conventional coagulation methods as well as drying techniques.

Deproteinised Natural Rubber (DPNR)

DPNR is a purified form of NR with very low levels of nitrogen, conferring to it properties of particular interest in engineering applications such as engine mountings. The processing of DPNR involves the removal of non-rubber components e.g. proteins in latex by the use of enzymes. Field latex is subject to enzyme treatment over 48 hours which necessitates the use of surfactants that maintained latex stability over longer hours, in place of conventional short-term preservatives like ammonia. As a result, it was necessary to coagulate using heat rather than acid. The technique of steam coagulation was developed at the RRIM to enable the efficient coagulation of DPNR. Subsequent size reduction and drying operations are similar to SMR production.

DPNR has currently found a niche market in its use for ‘hydro-mounts’ which are engine mountings used in the high-end German automobile market such as Mercedes, BMW and Opel. Marketing its use to the USA and Japanese automobile market and expanding its application to other areas is expected to increase the sales of DPNR substantially from the 400 tonnes sold in 1998. Although, RRIM is the sole producer of DPNR at present, efforts are underway to interest particularly smallholder agencies to set up processing facilities to cope with future demand for this grade.

Epoxidised Natural Rubber (ENR)

ENR is a chemically modified form of NR where the double bonds along the backbone of NR molecular chain is substituted with the epoxy structure. This confers ENR with properties that are not found in standard NR such as improved resistance to mineral oil, low air permeability, a good combination of high wet skid resistance with low rolling resistance and good damping characteristics.

Process development of ENR at the RRIM took a drastically different approach by considering it more as a chemical process rather than the conventional thinking on NR as a primary commodity. In other words, traditional NR processors interested in producing ENR, would require investment into non-traditional equipment like reactors, boilers, chillers, hazardous chemical storage and handling equipment as well as require the services of technically qualified personnel for the safe operation of such a plant.

The technology of ENR production was transferred from RRIM to a local commercial NR producer in 1990 and close cooperation with them on identifying new markets and expanding existing applications for ENR continues.

Liquid Natural Rubber (LNR)

The availability of NR in liquid form is considered a potential advantage for rubber
goods manufacturers who can then make use of such material as a performance enhancing substitute for rubber process oil. The R&D undertaken at the RRIM on chemically altering the molecular weight of NR to desired levels is meant to achieve this objective. As the resultant LNR is more co-compatible with NR than process oil, it will provide greater strength to the end product.

The molecular weight of LNR can also be lowered sufficiently to enable it to flow at room temperature. This makes it an important feedstock for the huge adhesive industry, with the distinct advantage that LNR is more environment friendly because of its water-based as opposed to solvent-based nature.

As with ENR, the process of LNR is more akin to chemical plant type operations rather than standard rubber processing. It involves reaction under controlled temperature conditions sustained over 10 to 20 hours, followed by coagulation using a combination of heat and chemical treatment and finally drying in specialised equipment fitted with vacuum to enhance drying of the viscous product. An important offshoot of studies on LNR is the latex version of this grade referred to as Depolymerised latex. Eliminating the need for drying unlike LNR, this material could prove to be a more cost-effective option for the water-based adhesive industry. R&D activities on LNR and Depolymerised latex are still at the pilot plant level at RRIM.

**Carbonblack Masterbatch (CBMB)**

Greater value-added will be accorded to NR if vertical integration of downstream rubber products manufacture with upstream NR processing is carried out. The production of CBMB is the first step in this value-added chain and does not involve the much higher capital investment required for full-blown product manufacture set up. NR processors and SMIs are ideally suited to produce CBMB tailor made to meet product manufacturer’s needs. Advantage can be taken of the situation faced by certain product manufacturers in the West and in Japan who by virtue of their plant location cannot carry out black-mixing due to environmental consideration.

R&D facilities to demonstrate the advantages of vertical integration of upstream with downstream activities are being presently set up at the RRIM. Whilst initially the work will confine itself to CBMB production and custom compounding, ultimately this facility will become available for hire by the numerous SMIs in the ‘Rubber City’ envisaged by the MRB. They will be able to conduct their own R&D as well as carry out initial production of industrial (IRG) and general rubber goods (GRG).

**Future Advances in Rubber Processing**

Substantial advances in NR processing were made in the sixties with the advent of SMR. New presentation coupled with technical specifications ensured the runaway success of block rubber’s acceptance by consumers. Further advances continued to be made in the form of developing specialty rubber grades to meet niche market needs. Grades such as ENR and DPNR developed at the RRIM are already being produced commercially while other specialty grades such as LNR and Depolymerised latex are in the R&D pipeline. Efforts are also underway to demonstrate cost benefits of vertical integration between upstream and downstream activities. Furthermore, in keeping with the RRS of the MRB, greater emphasis will be placed on improving existing markets and finding new applications for the NR grades developed in-house.

One other important area in which the RRIM has initiated R&D is in automation of certain factory processing operations. As a first step, the benefits of automation is being studied in that area of a block rubber factory where more than 75% of the total workforce is assigned viz. baling and crating operations. Automation of these operations will relieve NR processors from being subject to the vagaries of the labour supply situation. Ultimately it is envisaged that NR processing will be fully automated and computer controlled, bringing with it the advantages highly sought after by consumers i.e. consistency and quality in NR.

Finally, future advances in NR processing must take into cognizance the ever increasing awareness of environment quality both overseas and locally and the impact of ISO 14000 in all
industrial activity. Methods of extracting latex from a tree and maintaining it in its original sterile form for subsequent processing have important implications. The need for preservatives will be minimised or even totally eliminated. Physical rather than chemical methods could be employed for separating the rubber from the serum thereby doing away with the need to carry out costly end-of-pipeline effluent treatment. High value non-rubbers could be extracted and become an additional source of income for the Malaysian rubber grower who today constitutes mainly the low income smallholder sector.

Suggested Readings


