



APPENDIX II

US & Chilean Creosote Treated Hardwood Crosstie Service Life

US Facts

Mardones BPB Treating Facility

Shipping Capabilities and Port Locations

Global Customer Profile

Presented By

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And

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US Facts



CSXT Keystone Corridor tracks. FRA Class 6, maximum speed 110mph (176 Km/h). Annual Traffic 126 MGT

The wood crosstie service life in the US railroad network, a 140,000 mile (225,260 Km) network (World Bank 2013) has a very impressive and trustable record. Several reputable organizations (AAR, TTCI, TRB, NRC, RTA) and the railroads (hundreds of corporations) themselves have studied and documented the wood crosstie on-track performance and life span for almost 130 years.

93% of the US railroad network, approximately 130,200 miles (209,492 km), is supported on wood crossties. Ties laid on track in almost 98% of the cases are creosote treated ties (RTA 2014), which meet AREMA Standards (Attached in Appendix I), vastly presenting the same configuration showed in the picture above: 7"x9"x8'-6" tie, rail seat, cut spike and boxed anchors as the predominant fastening system, even in heavy haul freight, high speed passenger, transit and metro lines.

The service life of the wood ties can be quickly estimated by taking the average total ties renewed each year and dividing it by the total ties laid on track, in order to get the annual replacement rate. As it is possible to see in table 4, below, considering the period between 1960 and 1999, the US network has had an average wood crosstie renewal of 18.28 million ties per year on an average mileage of 272,076 miles (883.94 million ties laid on track), which results in an average service life of **48.35 years**.

Us History Tie Installations 1960 to 1999

Table 4: US Industry Tie Installations and Industry Performance Statistics

Year	No. Ties Installed	Track Miles	Annual MGT	Normalized Ties Installed
1960	16417000	358520	1.6	13579280
1961	13426466	338416	1.77	10918318
1962	15206006	335055	1.86	12039393
1963	15120230	332971	1.95	11632458
1964	16546000	347107	1.94	11255754
1965	16982000	345422	2.02	11266710
1966	17699000	344001	2.15	11723202
1967	17458000	341499	2.11	11811301
1968	19006000	339781	2.19	13858314
1969	20088000	338795	2.27	14305005
1970	19611000	336332	2.27	13981941
1971	22777000	334932	2.21	16633538
1972	22251000	331129	2.35	16025611
1973	19893000	328625	2.59	13434155
1974	21175000	327285	2.6	15883134
1975	20548000	310941	2.43	17055405
1976	27002000	312770	2.54	22964140
1977	27270000	310800	2.66	22555267
1978	27228000	309700	2.77	22660092
1979	26667000	300000	3.05	21335026
1980	25984000	270623	3.4	22226987
1981	26529000	267589	3.4	22950487
1982	20726000	263330	3.03	20209822
1983	20086000	258703	3.2	19146785
1984	23581000	252748	3.65	21741405
1985	20736000	242320	3.62	20063248
1986	18104000	233205	3.72	18656413
1987	14768000	220518	4.28	14507831
1988	14046000	213669	4.66	14341146
1989	13458000	208322	4.87	13641189
1990	14309000	200074	5.17	15577325
1991	12844000	196081	5.3	14007411
1992	13690000	190591	5.6	15906759
1993	13233000	186288	5.95	15040790
1994	12896000	183685	6.54	13604341
1995	12784000	180419	7.24	12735080
1996	14269000	176978	8.02	13725397
1997	13363372	172564	7.82	13431748
1998	12185000	171098	8.05	12586714
1999	11574711	169766	8.5	11574711

Gauntt C. James & Zarembski M. Allan. Analysis of Wood Cross-Tie Price Sensitivities, 2000

However, a more precise calculation of the lifespan of the crossties requires the consideration of several critical factors such as traffic density, track geometry and environmental conditions (climate).

Of said factors, possibly the most relevant is traffic density. The table below presents a general classification of tracks, from A to D, depending on traffic density, where it is possible to verify that the tie's life may approximately go from **20 to 40 years** in the majority of the cases.

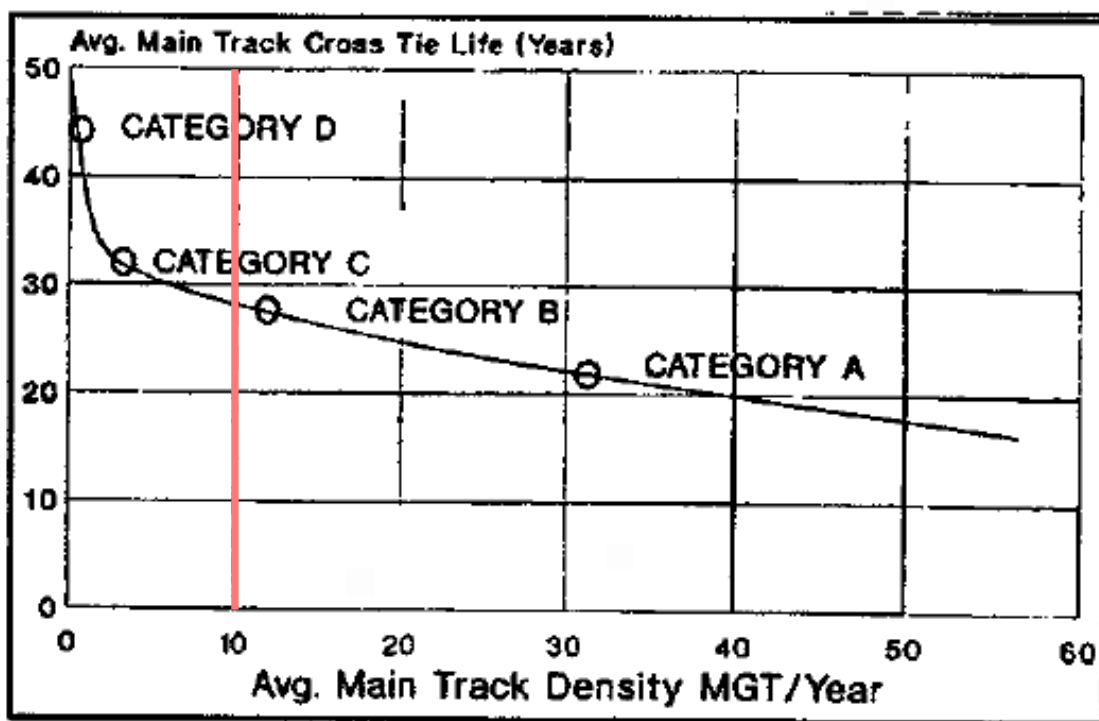


Figure 2 — Tie life versus tonnage, from 1978 industry statistics²

Zarembski, A.M. Forecasting of Track Component Lives and its Use in Track Maintenance Planning, International Heavy Haul Railways Association Transportation Research Workshop Vancouver, BC June 1991.

The AAR and the USDA Forest Service, Forest Products Laboratory, have done an update of 35 years of the Industry's statistics, which in 2008 Zarembski M. Alan presented in the Update on Wood Tie Life RTA Report # 1 2008, (Support Doc III).

In this work it is feasible to check that, considering all factors, the creosote treated wood crosstie lifespan goes from **25 to 35 years** in the majority of the cases as is shown in the tables and figures extracted from the report in the following pages.

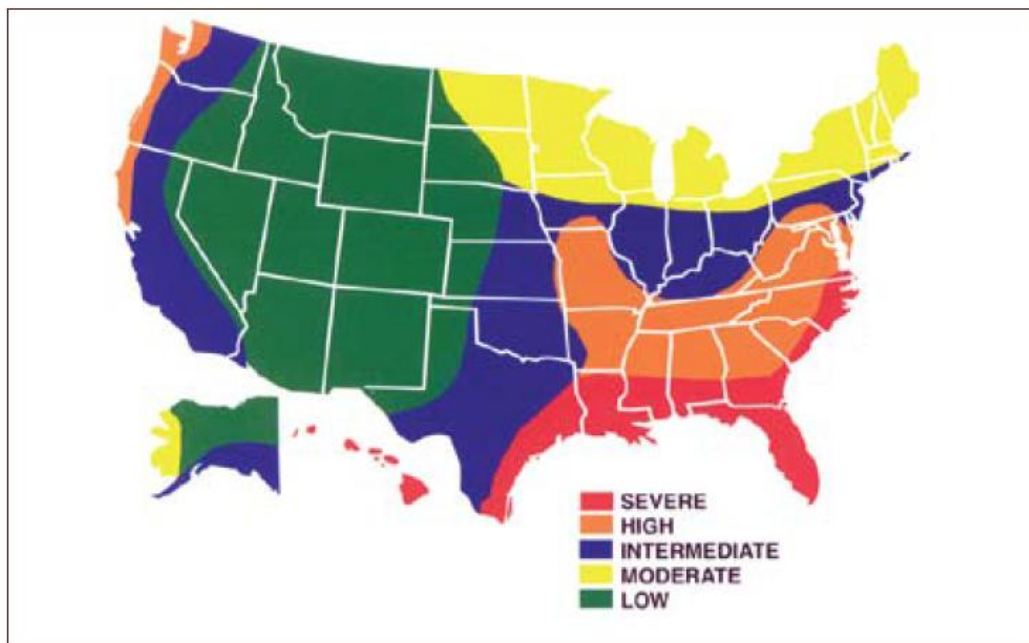
Table 1: Tie Life Factors

Traffic Characteristics	<ul style="list-style-type: none"> • Traffic Density or Tonnage (Annual MGT) • Axle Load • Speed • Traffic Type
Track Geometry	<ul style="list-style-type: none"> • Curvature • Grade
Track Type and Condition	<ul style="list-style-type: none"> • Rail Section (weight) • Welded Rail (CWR) vs. Jointed Rail • Fastener Type • Ballast/Track Support
External Factors	<ul style="list-style-type: none"> • Environment (climate, temperature, humidity, decay hazard) • Biological factors (termites, fungi, etc.) • Wood type (e.g., hardwood vs. softwood)

Of these factors, three can be considered to be the dominant factors for conventional wood tie, cut spike track:

- Tonnage
- Curvature
- Environmental Conditions (Decay Hazard) [Figure 2]

Figure 2: Decay Hazard Map of U.S.



The first two factors directly affect the rate of mechanical degradation of the ties. The third factor directly affects the rate of decay of the tie.

Figure 4: Curvature Sensitivity

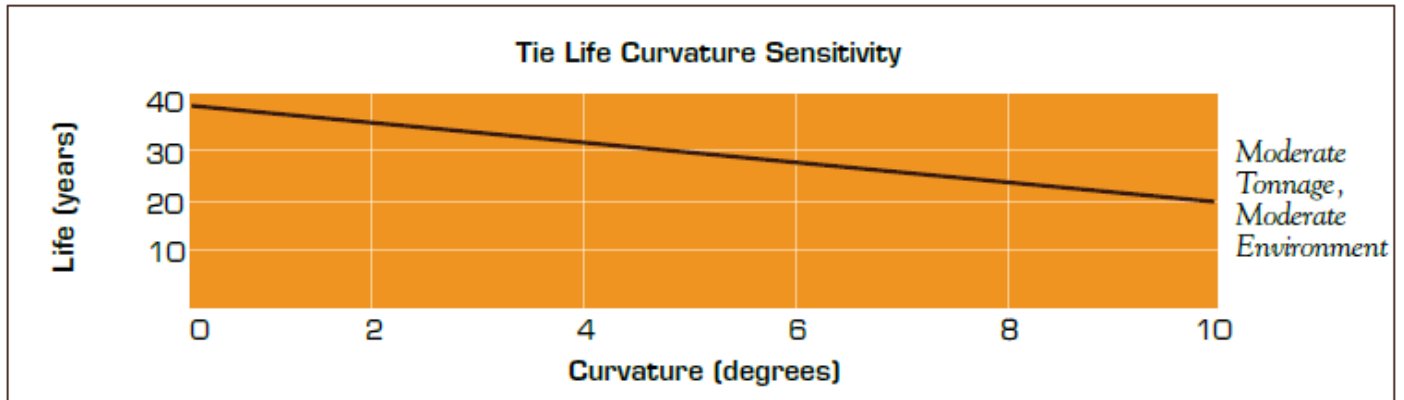


Figure 4 presents the sensitivity of tie life to curvature, defined in degrees of curvature.

Figure 5: Tonnage Sensitivity

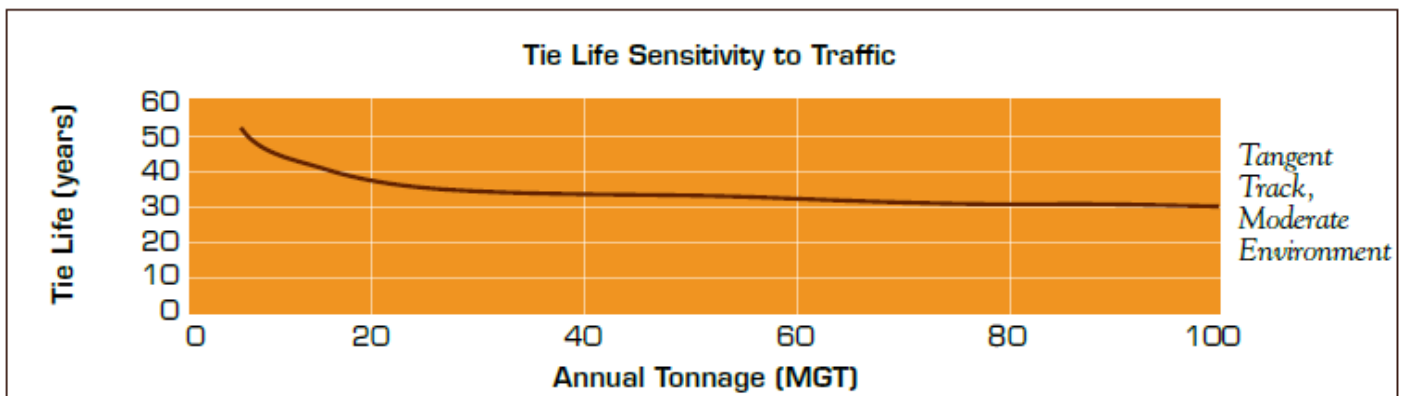


Figure 5 presents the sensitivity of tie life to traffic density, defined in terms of annual tonnage of MGT per year.

Figure 6: Environmental Sensitivity

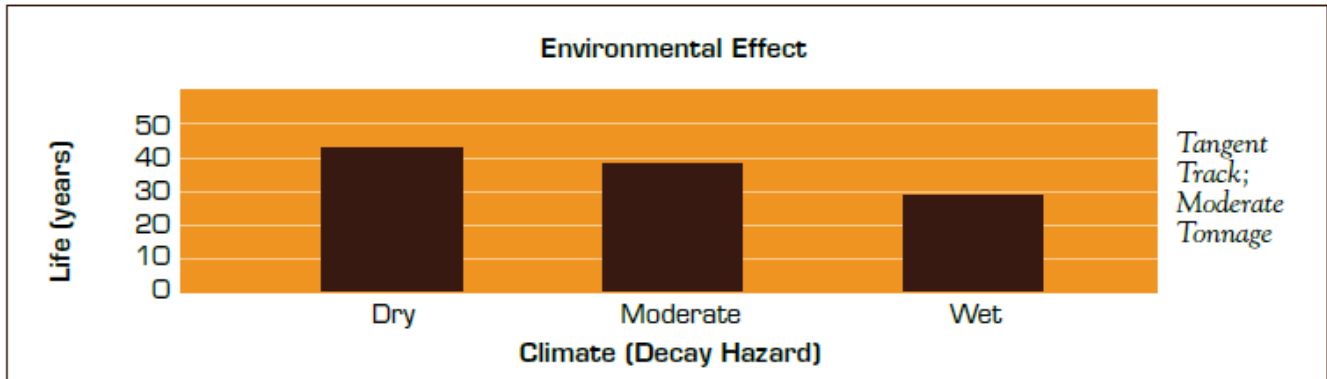


Figure 6 presents the sensitivity of tie life to environmental or climatic condition. This is directly related to the Decay Hazard map presented in Figure 2 and can be simplified as follows:

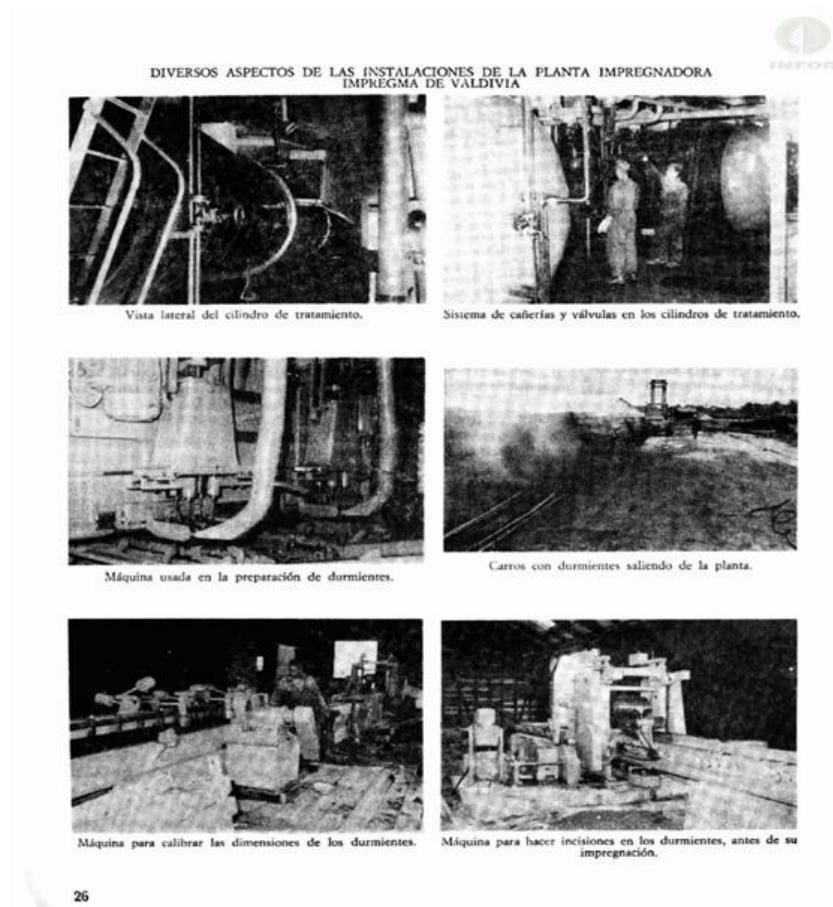
- “Dry” Climate Track: Representative of Western U.S.
- “Moderate” Climate Track: Representative of Northern U.S.
- “Wet” Climate Track: Representative of Southeastern U.S.

Chilean Creosote Treated Hardwood Crosstie Service Life

The first hardwood crosstie creosote treating plant in Chile belonged to the Chilean State Railways Corporation (Empresa de los Ferrocarriles del Estado, EFE) and was installed in 1950 in a place called "Chumpullo", nearby Valdivia City. At this facility 4 million ties were treated before the railroad financial crisis in the 70's forced authorities to close it down in 1972 (Guajardo, Guillermo, 2007; INFOR, 1967, Clasing, Armin, 1995).

Below, a few old pictures of that treating facility when it was operating:

First Wood Treating Plant in Chile - Chumpullo, Valdivia 1950



Boletín Informativo N°14, 1967 "La Preservación a Presión de Maderas en Chile", Instituto de Investigación Forestal, Santiago – Chile /0010559/

The EFE Railroad Fuel & Tie Storage Chief Engineer (1968 - 1978), Mr. Armin Clasing, stated in his Essay "Railroad Ties in Empresa de los Ferrocarriles del Estado de Chile" (1995) that creosote treated Chilean Hardwood ties on the EFE tracks have proven to have a service life of 30 years.

Furthermore, the REDEFE Manual (Design Recommendations for Railway Infrastructure Projects, prepared by the Planning and Cooperating Ministry - 2003), on its Section 7.5.2.1 "Wood Crossties", states that creosote treated Chilean hardwood ties have had a service life over 30 years.

It is interesting to note that the crosstie experience mentioned by Clasing and the REDEFE Manual are based on the State owned railroad (EFE) tracks in the Central Corridor, known as "Linea Central Sur", a 634 mile (1,020 Km) corridor

linking Santiago and Puerto Montt cities. This Corridor used to support 10 to 20MGT annual tonnage traffic and used to operate in FRA Class 6 Track Standard (EFE Class E Track). Climate condition on the corridor varied from temperate to rainy temperate, which is similar to the blue zones in the Decay Hazard US Map (page 4), i.e., it has an intermediate decay hazard.

In the CWR Section, completely built in the late 60's, almost no tie replacements were done until the late 90's, as it is presented in the next two pictures.

CWR Track Section, between Santiago and San Rosendo cities, built in 1965 - 1971



Km. 155, South San Fernando Station. EFE Class E Track, 160 Km/h (99mph) maximum speed, 2005

Right after the Chilean State Railways Corporation (EFE) started a USD 2 billion upgrade program (1994 - 2005), a second creosote tie treating plant was established (1998) in Yumbel village, close to Concepcion city.



The new factory was designed by the US crosstie producer The Burke - Parsons - Bowlby Corporation (BPB), a relevant player in the US tie market (lately bought by Stella - Jones, one of the biggest crosstie producers in North America). As a matter of fact BPB supplied all of the new industry equipment from the USA, supervised the factory's construction, trained key personnel and directed the plant's operation in its beginnings. In addition to the technical support, BPB kept until 2008 a minor interest as a stockholder in Mardones - BPB Creosote Treaters S.A., the private entity which owns and operates this facility.

Yumbel treating plant initially was a USD 2 million investment, with capacity to treat 420,000 standard gauge ties per year under optimum conditions. Since the firm started operating in 1998, it has produced 2.6 million ties serving Chilean rail operators such as: Chilean State Railways Corporation (EFE); Valparaiso Metro (MERVAL); Santiago Metro (Metro SA); El Teniente 8 copper mine railroad (FF.CC. Teniente 8); The Antofagasta (Chili) & Bolivia Railway P.L.C. (FCAB); Pacific Railroad (FEPASA). Additionally, the Yumbel treating facility has served other foreign railways in America, Africa, Middle East and Asia Pacific, such as: Ohio Central System (test sample) in the USA; INCOFER (Costa Rica); Ferroatlantico (Colombia); Ferrovias Central Andina, Perurail and Southern Peru Copper Corporation (Peru); Ferrocarril Andino (Bolivia); Spoornet (South Africa); Almobty Contracting (Saudi Arabia); APTA - Alexandria (Egypt); Kiwirail (New Zealand) and Sampyo (Korea).

The source of raw material (timber), mainly Chilean Oak and Chilean Beech (See Appendix I), for this industry is a 33 million acre (13.4 million hectare) Temperate Forest, which is privately owned and managed sustainably. Moreover, the timberland belongs to approximately 100,000 individuals. Although this resource belongs to privates, Chilean laws (Decree Law 701 and Law 20.283) establish that every harvest activity, or any kind of forest intervention, must be done under the regulation of a Management Plan prepared specifically for each area of the property to be managed. The Plan shall be prepared by a forestry engineer and approved by the Chilean Agricultural Ministry Forest Service (Corporacion Nacional Forestal - CONAF). Each approved Management Plan will provide the timberland owner not only the forest management guidelines, but also a specific limited quantity of transport permit forms (sealed and numbered) issued by CONAF, that shall accompany every truckload of wood products obtained from the approved harvest. CONAF officers and National Police control all transportation media carrying forest products, guaranteeing that they always have the transport permit form and always come from an approved harvest. Anyone violating the Forest Law will be prosecuted. Besides the privately owned timberland, the Chilean State owns over 46.9 million acres (19 million hectares) of National Parks.

Mardones BPB Yumbel, Chile Treating Facility

The following images present the Mardones- BPB treating facility operations including procurement, end plating, storage, treating plant, shipping capabilities, port locations and applications of the Yumbel creosote treating plant wood products.



Madones- BPB Office and Support Building



Green Sleepers/Ties and Treating Plant

Mardones BPB Yumbel, Chile Treating Facility

Procurement – Yumbel is located in the middle of a vast, dense Temperate broadleaf timber forest resource in Chile. The procurement area is 33 million acres forest (13.4 million hectares) of private land and 46.9 million acres (19 million hectares) of Chilean State owned, all regulated and sustainably managed. These images below depict this Temperate forest resource procurement area available to Mardones-BPB.



Temperate Broadleaf Forest Resource

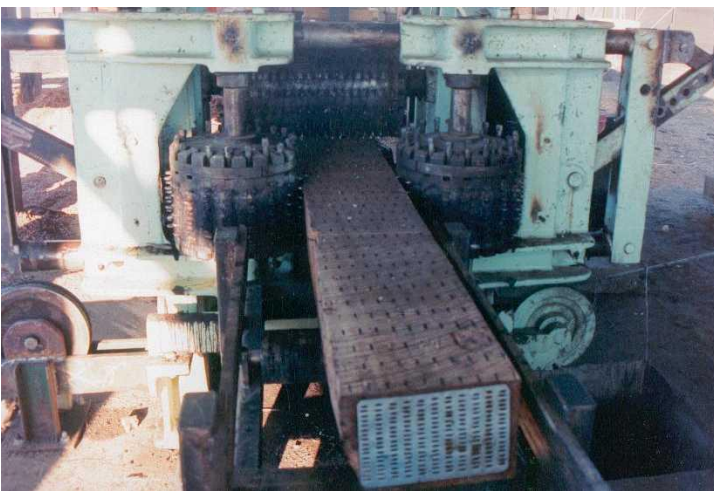


Dense Forest Resource

Mardones BPB Yumbel, Chile Treating Facility



Green Sleepers/Ties From Local Mills



Incising Sleepers/Ties At The Treating Facility

Mardones BPB Yumbel, Chile Treating Facility



End Plated Sleepers/Ties In Storage Prior To Treatment



Cooling Tower for Condenser



Containment Area For Filling Storage Tanks

Mardones BPB Yumbel, Chile Treating Facility



Preservative Storage Tanks



Cylinders, Surge Tanks and Condensers



Cylinders, Surge Tanks, Condensers and Work Tanks for Pressure Treatment of Sleepers/Ties

Mardones BPB Yumbel, Chile Shipping Capabilities & Port Locations



Sleepers/Ties Shrink Wrapped for Containers Loading



Sleepers/Ties Loaded for Break-Bulk



Crosstie exports, Talcahuano (Chile) docks
AREMA Grade 7 Inch ties being shipped to
Alexandria, Egypt



Crosstie exports, Talcahuano (Chile) docks
AREMA Grade 7 Inch ties being shipped to
South Africa

Concepcion Bay & Valparaiso Port Loading Locations



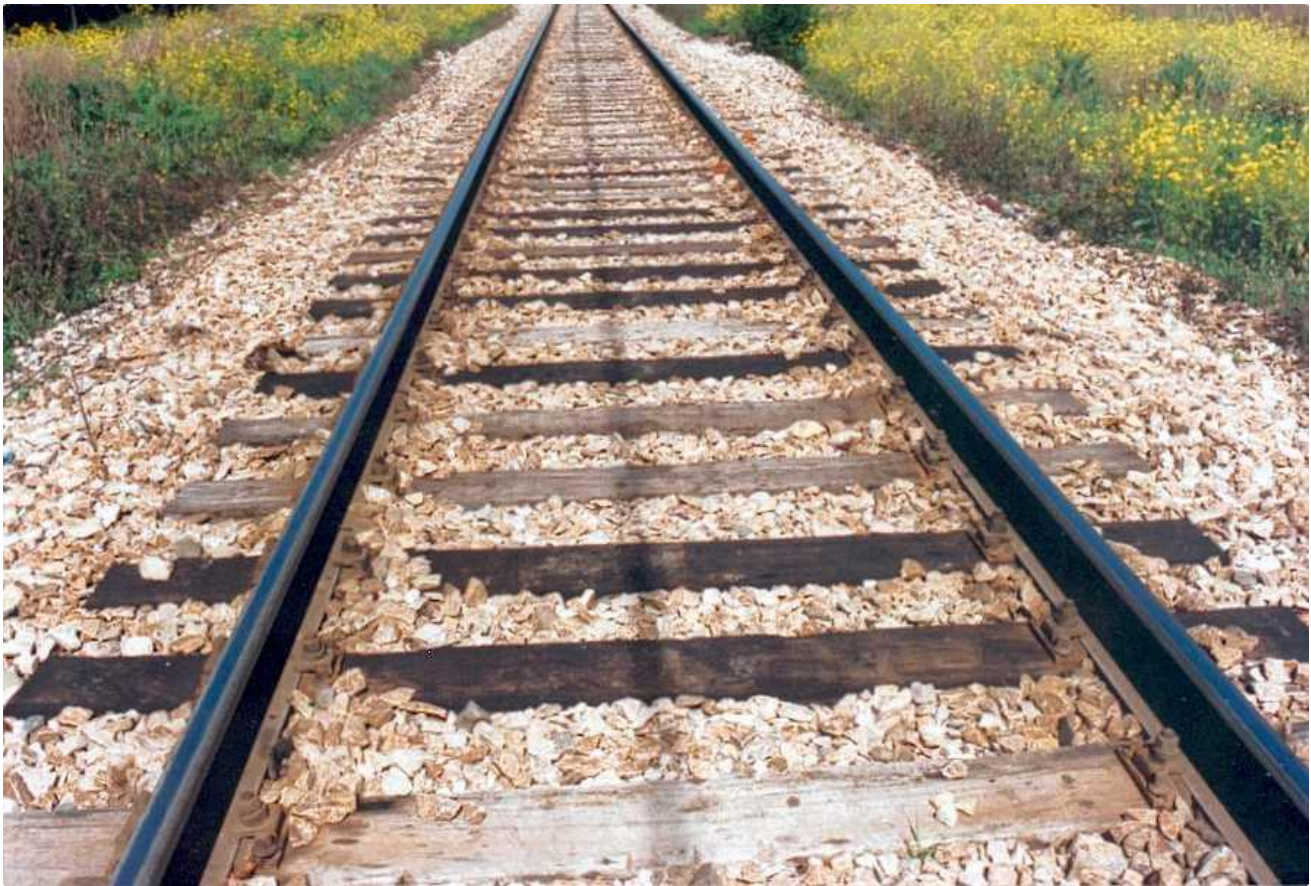
Container and Break-Bulk Loading Capabilities



Container and Break-Bulk Loading Capabilities

Global Customer Profile

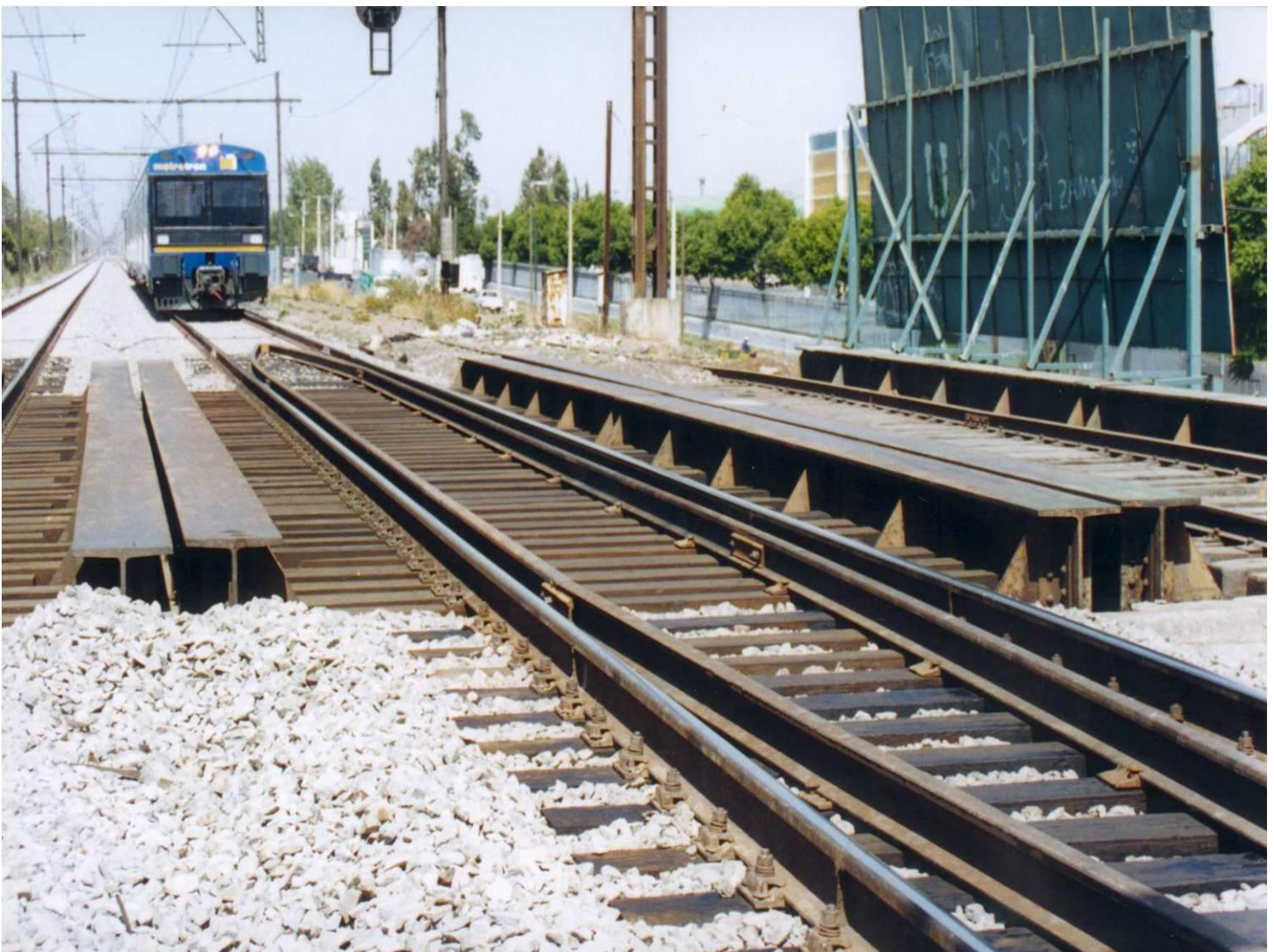
EFE - Chilean Railways Corporation tracks, Km. 380, nearby Chillan Station



EFE Class E track, maximum speed 160Km/h (99 mph). Annual Tonnage: 10 MGT

Global Customer Profile

Metro - tren Transit, Southern Access to Santiago City (Chile)





EFE Class E tracks, 160Km/h (99 mph) maximum speed. Traffic density: 10 MGT / Year

Global Customer Profile

MERVAL - Valparaíso (Chile) Metro - tracks



EFE Class D tracks, maximum speed 140 Km/h (87 mph). Traffic density: 10 MGT / Year

Global Customer Profile

FF.CC. Teniente 8, Copper Mine Railroad (Codelco Chile - Chilean Copper Corporation)



FRA Class 4 tracks

Traffic density: 136 MGT / Year

Train traffic: 180 convoys per day (one train every 14 minutes, 24 hours a day, 365 days a year)

Axle load: 70,548 lbs (32 tons)

Maintenance window: 2 hours per day

Remote controlled train operation



This is a heavy haul operation, similar to the heaviest Class I US freight railroads

El Teniente 8 Railroad Supply Certification



Certificado

FF.CC TTE8-NI-225/2014

Colon Alto, Diciembre 2 de 2014

A: **Mardones BPB – Durmientes Creosotados**
De: **Ferrocarril Teniente 8**
Ref: **Certificado de Rendimiento de Vías y Materiales**

Por medio de éste venimos en certificar que el Ferrocarril "El Teniente 8" es una operación ferroviaria pesada de la gran minería del cobre que moviliza 96 trenes cargados diariamente, contando con un peso por eje normal de 32 toneladas en vagones cargados, desplazando 140 millones de toneladas brutas (MGT) por año en una vía de trocha 1.435 mm.

Desde el punto de vista del mantenimiento, las condiciones son complejas: sólo contamos con una ventana de mantenimiento de dos horas diarias y debemos manejar un alto y permanente contenido de humedad en la plataforma (bolsillos de agua y arcilla) proveniente de escurrimientos subterráneos como también un volumen considerable de finos del mineral que caen de los carros a la vía en forma permanente colmatando el balasto y perjudicando el drenaje. Así, cada nueve o diez años debemos remover todos los componentes de la vía. El riel de 136 [lb/yd] debe ser renovado cada tres años. Por sobre estas consideraciones, el estrecho gálibo en la vía del túnel de la mina limita seriamente el tipo de equipamiento que puede ser usado.

Los durmientes de 7"x9"x8'-0" son hechos de coihue (*Nothofagus dombeyi*) creosotado en la planta de Mardones - BPB y rinden satisfactoriamente hasta el momento en que deben ser removidos cada nueve o diez años junto con el programa de overhaul (rehabilitación).



Gonzalo Viver Gallegos
Jefe de Proceso – Ferrocarril Teniente 8

Codelco Chile – División El Teniente
Avenida Antonio Millán #1020 – Rancagua
Código Postal: 2851207
Rancagua – Chile



El Teniente 8 Railroad Supply Certification



Certificado

FF.CC TTE8-NI-225/2014

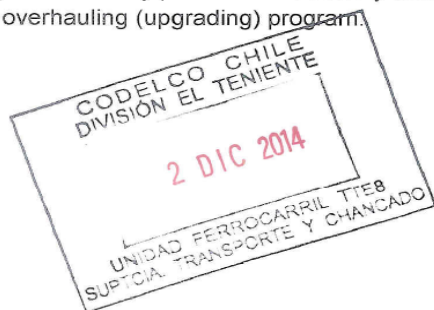
Colon Alto, December 2 de 2014

To: Mardones BPB – Creosote treaters S.A
By: Ferrocarril Teniente 8
Ref: Track & Material Certificate of performance

We hereby certify that "El Teniente 8" railroad is a heavy haul copper mine rail operation that runs 96 loaded trains a day, having 70,548 [lbs] as regular loaded car axle load, moving 140 MGT per annum on a 4'-8 1/2" gauge track.

From maintenance point of view, conditions are complex: we only have two hours a day maintenance window and have to manage constant roadbed high moisture content (including ballast water & clay pockets), coming from groundwater flow, as well as with a considerable volume of copper ore smallest particles, permanently dropping off cars, clogging ballast and impairing drainage. Thus, every nine or ten years we must remove all track components. The 136 [lbs/yd] rail must be renewed every three to four years. On top of these considerations, narrow clearance in the mine tunnel track severely limits type of equipment that can be used.

7"x9"x8'-0" crossties are made out of coihue (*Nothofagus dombeyi*), creosote treated in Mardones - BPB plant and they perform satisfactorily until we remove them every nine or ten years as part of the track overhauling (upgrading) program.



Gonzalo Vivar Gallegos
Project Manager – Ferrocarril Teniente 8

Codelco Chile – División El Teniente
Antonio Millán Avenue #1020 – Rancagua
Postal Code 2851207
Rancagua – Chile

Global Customer Profile

CAP - CMPC Iron mines at Huasco (Chile) Pellet Terminal Docks



FRA Class 3 tracks

Traffic density: 11MGT / Year

Global Customer Profile

FCAB tracks, Antofagasta (Chile)



FRA Class 3 tracks

Traffic density: 7 MGT / Year

Global Customer Profile

South Africa Railway Track Structure



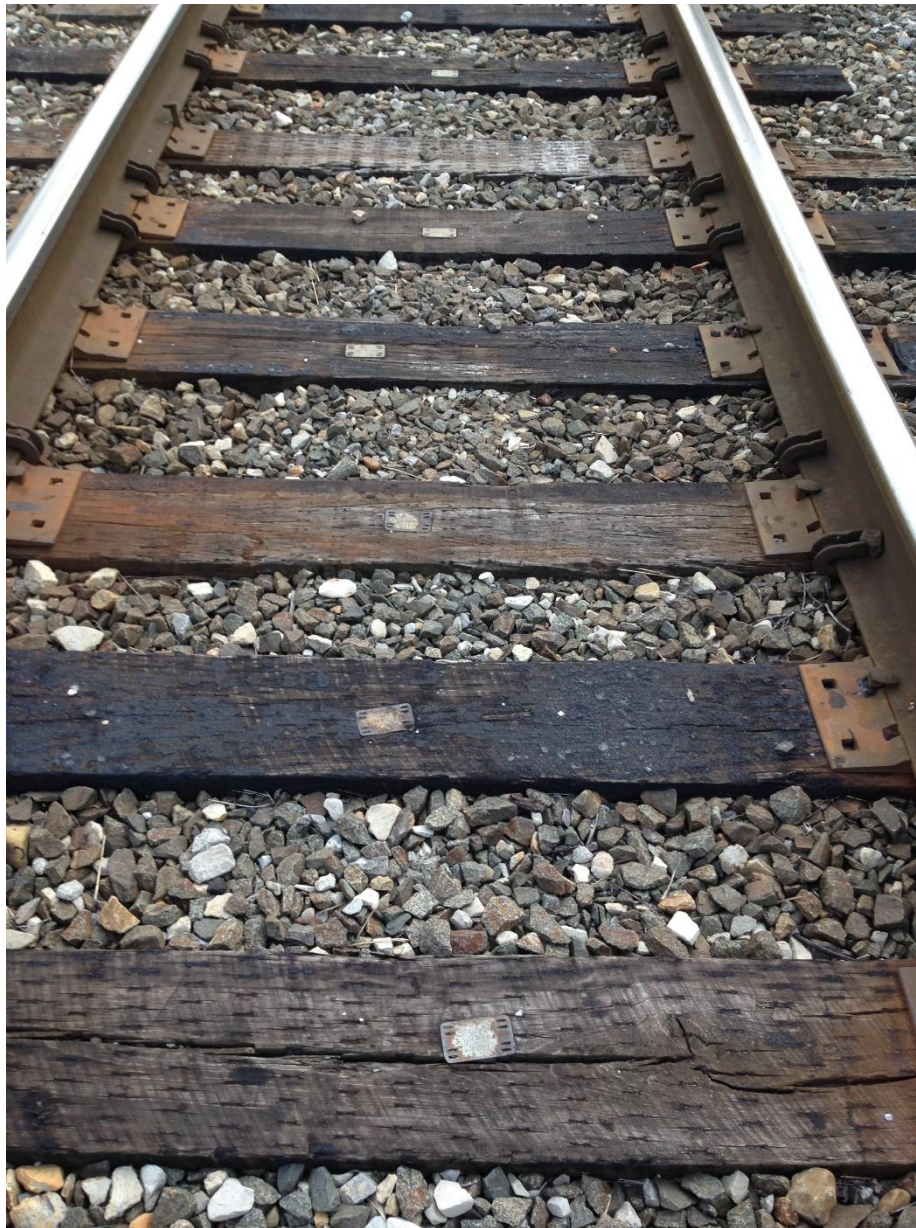
Switch ties & Crossties

FRA Class 5 track

Traffic density: 12 MGT / Year

Global Customer Profile

Ohio Central System, Newark, Ohio, USA



FRA Class 4 track

Global Customer Profile

APTA, Alexandria Passenger Transportation Authority (Egypt)



Switch ties & Crossties

FRA Class 3 Tramway tracks

Global Customer Profile

Ferrovías Central Andina Railroad, Tamboraque, Perú



Bridge ties

FRA Class 2 tracks

Traffic density: 4 MGT / Year

Global Customer Profile

Perurail, El Cusco, Peru



FRA Class 4 tracks

Traffic density: 6 MGT / Year



In Summary

ABC Tie Tech International and Mardones-BPB appreciate the opportunity to present this treated wood cross tie presentation to our customers. We look forward to answering any questions and providing any additional information that is requested. At this time we also want to extend an invitation for all railroads' personnel that would be interested in touring our Yumbel, Chile treating facility. We also look forward to meeting with you in the near future.

Kind Thanks,

Tony Chambers

Gonzalo Mardones