

# Dissolvable Rubbers

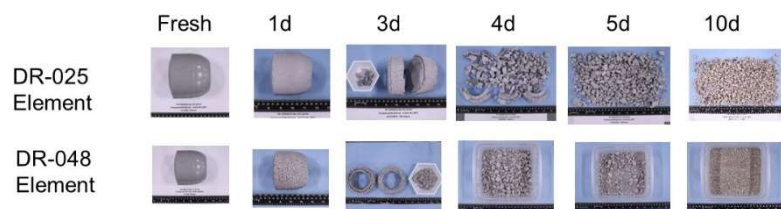
CNPC-USA has developed a series of dissolvable rubbers in the temperature range from 40°C to 175°C to meet various operation requirements. Comparing to the commercial dissolvable rubbers in the market, CNPC-USA dissolvable rubbers have high elongation, high modulus, and high tear strength. The dissolution rate of the dissolvable rubbers could be designed. The cost of manufacturing was competitive.

## APPLICATIONS

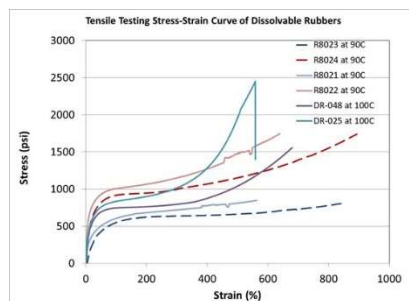
- Sealing elements for dissolvable plugs
- Dissolvable sealing materials for various completion, drilling, and measurement tools

## FEATURES & BENEFITS

- CNPC-USA designed dissolvable rubber formulations and manufacturing process
- Wide temperature ranges from 40°C to 175°C
- The dissolution and mechanical properties could be controlled. The dissolution rate of the CNPC-USA dissolvable rubber was faster than that of the dissolvable rubbers in the market
- The dissolvable rubber have elongation, > 300%, high modulus, high tear strength at high temperature
- The dissolution rate is not affected by the salinity
- The dissolvable rubbers could be fully dissolved at certain temperature



The dissolution progress of DR-025, DR-048 element at 80°C in brine



The tensile properties of MT dissolvable rubbers

## SPECIFICATIONS

Properties	Unit	HT 120-150°C Fast Dissolution Rate <sup>c</sup>		MT 90-120°C Mid Dissolution Rate	MT 90-120°C Fast Dissolution Rate		MT 80-120°C Fast Dissolution Rate <sup>a</sup>		LT 50-80°C Fast Dissolution Rate <sup>b</sup>		LT 40-70°C Fast Dissolution Rate <sup>d</sup>
		DR-043	DR-127	R8021	R8027	R8028	DR-048	DR-025	DR-045	DR-046	DR-068
Hardness, Shore A		95	95	87	86	93	96	93	85	85	75
50% Modulus, 90 °C	psi	657	897	521	431	812	699	754	532	517	341
100% Modulus, 90 °C	psi	666	928	634	541	905	749	828	632	620	428
200% Modulus, 90 °C	psi	708	926	721	606	936	765	898	718	706	526
Tensile Strength, 90 °C	psi	1474	1758	1290	801	1728	1317	2419	N/A	N/A	>1900
Elongation at Break, 90 °C	%	474	750	565	903	916	622	577	>600	>600	>650
Disintegration/Dissolving Time, 40 °C, 0.3% KCl	day	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9-10	7-8	3-7
Disintegration/Dissolving Time, 50 °C, 0.3% KCl	day	N/A	N/A	N/A	N/A	N/A	5-10	N/A	5-8	3-5	N/A
Disintegration/Dissolving Time, 80 °C, 0.3% KCl	day	N/A	N/A	15-20	6-7	7-8	4	5-7	N/A	N/A	N/A
Disintegration/Dissolving Time, 90 °C, 0.3% KCl	day	N/A	N/A	8-15	3-5	4-6	1	1	N/A	N/A	N/A
Disintegration/Dissolving Time, 120 °C, 0.3% KCl	day	7-8	N/A	1-3	1-2	1-2	<1	<1	N/A	N/A	N/A
Disintegration/Dissolving Time, 95 °C after 140°C for 1day, 0.3% KCl	day	15-20	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Field Cases Oil Fields				Southwest		Daqing	Southwest, Daqing, Xinjiang		Daqing		
a: Tensile properties at 100°C		b: Tensile properties		c: Tensile properties at 150°C			d: Tensile properties at 40°C				

## FIELD CASES

The dissolvable rubber elements developed at CNPC-USA have been successful applied in many fields in China, including Southwest, Daqing, Xinjiang Oil Fields, etc.

### Field Case Example:

In June 2020, 20 dissolvable plugs with MT dissolvable rubber element were used in the Weiyuan Wei202H56-4 full well. The maximum pressure of the well was 88 MPa, and dissolvable plug was soaked for up to 16 hours, the dissolvable plug could maintain stable pressure holding. During the milling process, 13 stages passed through without any obstruction. For the rest of 7 stages, The maximum milling time was 10 minutes and the minimum was only 3 minutes.



Weiyuan Wei202H56-4 field and the dissolvable plug used in the field