MITSUBISHI CHEMICAL

DIANAL™ | DIACRON™

Toner Resin

DIANAL™ | DIACRON™ Toner Resins

Developing toner resins for over 30 years, Mitsubishi Chemical has extensive knowledge and understanding of the printing market. Our chemical expertise and vertical integration ensure tight control of the molecular weight distribution, which provides the ideal balance between low energy fusing and anti-hot offset.

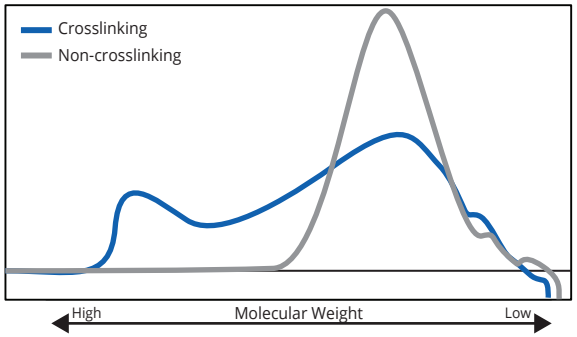
Mitsubishi Chemical's pigment design technology has earned an excellent reputation of high-quality products with a robust product lineup. With expertise in emulsification polymerization and coagulation control technology that can customize grain form and size, these toner resins deliver high resolution material through various development processes.

DIANAL™ Styrene Acrylic Resin

These resins feature high gel content, providing the advantage of anti-hot offset. With low energy usage and high-speed fusing, DIANAL™ resins offer good molecular weight control. The good dispersion of wax adds durability, while the polar group allows for good charge control.

DIACRON™ Polyester Resin

These resins have very low energy usage and high-speed fusing, which offers great molecular weight control. The DIACRON™ color toner is non-magnetic, providing great durability. These resins have good anti-hot offset properties as well as good dispersion of ester wax. Additionally, the negative pole has great charge control.

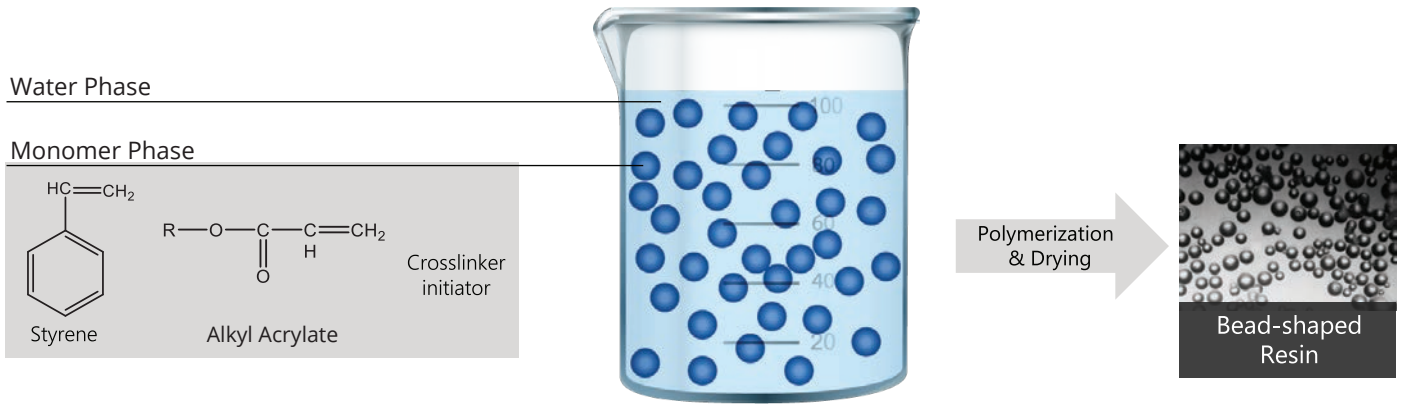


Performance Requirements	General Performance	
	DIANAL Styrene acrylic resin	DIACRON Polyester resin
Low energy & High speed fusing (Mw control)	✓	✓ ✓
Anti-hot offset (Gel content)	✓ ✓	✓
Non-magnetic color toner (Toughness)	x	✓ ✓
Dispersion of WAX (Durability)	✓	Ester WAX：✓ Olefin WAX：x
Charge control (polar group)	✓	Negative charge：✓ ✓ Positive charge：x
Environment (TVOC etc.)	x	✓
Resin cost	✓ ✓	x

General Performance ✓ ✓: great, ✓: good, x : poor

Suspension Polymerization

Mitsubishi Chemical toner resins are created through our proprietary suspension polymerization method that significantly reduces odor as well as leaving very few residual monomers. In addition, they do not use solvents, which makes them eco-friendly.

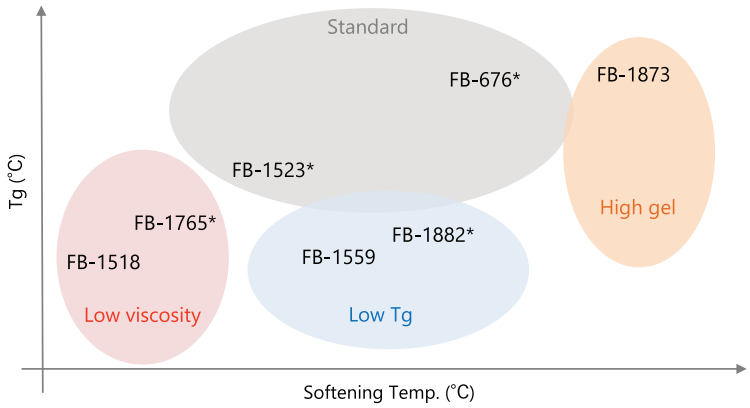


DIANAL™ Toner Resins

Styrene-Acrylate

The DIANAL™ styrene-acrylate toner resins includes a range of standard, high gel, low viscosity and low Tg offerings. The low VOC release of these resins is a major advantage, ensuring odorlessness during coping.

- High gel - Provides toughness and advantages for anti-hot offset
- Low viscosity - Good fusing properties
- Low Tg - Wide fusing window



*High acid value

DIANAL™ Product line

Dianal		FB-1518	FB-1559	FB-1873	FB-1882	FB-1765	FB-1523	FB-676
Design of resin		Non-crosslinked	Crosslinked - Low acid value		Crosslinked - High acid value			
Resin	T1/2(°C)	110	145	164	147	124	140	154
	Tg(°C)	55	55	62	55	56	57	61
	Gel content (%)	0	30	42	39	4	12	37
	AV (mgKOH/g)	0.5	0.3	0.1	5	11	9	13
	Mn	6600	8400	6900	4200	7400	9600	3400
	Mw	24300	131300	72400	54700	147100	203000	93000
	Mp	20000	33900	30500	14200	18700	30000	28400
After Kneading	T1/2(°C)	110	130	142	127	122	132	140
	Mn	7500	8400	8400	6300	10000	12400	5800
	Mw	24000	386000	458500	310000	96400	264500	369100

*Kneading by extruder (PCM-30) set temperature : 120°C

Tg : Glass Transition Temperature - Measured with DSC after melt quench and shown shoulder point. Heating Rate : 10°C/min

T1/2: Softening Temperature. Measured with SHIMADZU FLOW TESTER CFT-500. T1/2 is the temperature at which half of the sample has just flowed out. Nozzle: 1 mmΦ × 10 mmL, Plunger: 1 cm^2, Load: 30 kgf, Heating Rate: 3°C/min, Sample Filled: 1 g

Gel Content - Measured by insoluble residue with THF.

Acid Value - Measured by titration with KOH in Toluene.

Molecular Weight - Measured with GPC (THF solvent).

DIACRON™ Toner Resins

Polyester

The DIACRON™ polyester toner resin product line includes a range of standard, low-, middle- and high-viscosity as well as high gel. A major advantage of DIACRON™ resins is the low VOC release, which ensures odorlessness during coping.

- High gel - Wide fusing window
- Low viscosity - High gloss and low-energy fusing
- Middle viscosity - high gloss and wide fusing window
- High viscosity - Toughness and anti-hot offset

DIACRON™ Product Line | Conventional Catalyst

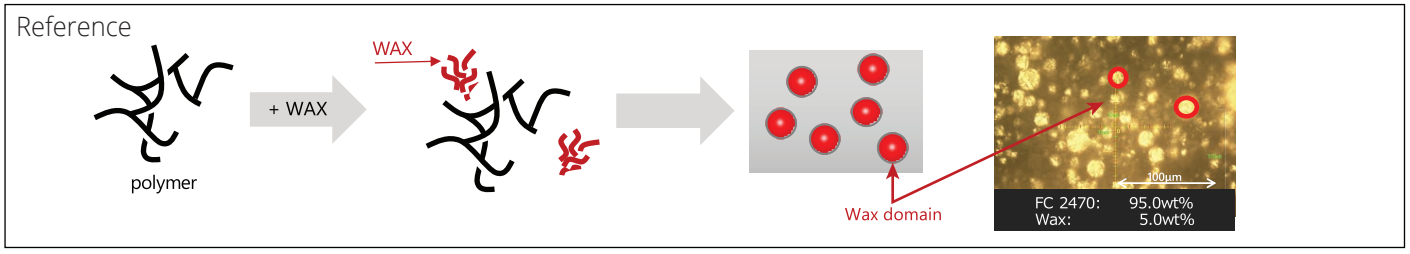
Grade	Resin Design	Tg (℃)	T4 (℃)	A.V. (mgKOH/g)	Gel ※ (wt%)	Mw※	Mn※
ER-508	Standard	63	127	8	5～15	110,000	3,600
FC-023	Standard	63	140	8	5～15	121,000	3,400
FC-433	Standard	57	137	5	＜10	124,000	3,600
ER-590	Standard	59	129 ※2	4	＜10	142,000	3,500
FC-1478	High gel	62	142	7	10～20	92,000	3,300
FC-2232	High gel	64	161	8	15～20	57,000	2,700
FC-2961	Wax dis.	59	139	7	15～20	57,100	1,600
FC-316S	High viscosity	70	156	11	10～20	145,000	3,600
FC-111	High viscosity	66	151	10	<10	155,000	3,600
FC-2486	High viscosity	63	164 ※2	9	15～20	81,700	2,600
FC-1494	Full color	62	127	6	＜5	113,000	3,400
FC-1565	Full color	62	121	6	＜5	72,900	1,900
FC-1894	Full color	58	130	6	10～15	107,900	2,500
FC-1981	Full color	68	132	5	＜ 5	22,000	3,600
FC-2170	Full color	67	133	7	＜ 5	40,000	3,300
ER-502	Low viscosity	57	110	12	＜ 5	26,000	2,700
FC-916A	Low viscosity	62	110	10	0	7,800	2,300
FC-1588	Low viscosity	53	93 ※2	9	0	4,700	2,900
ER-535	Low viscosity	60	99 ※2	7	0	8,000	2,800
ER-561	Low viscosity	60	106	6	0	7,500	2,800
FC-2497	Wax dis. of ER-561	57	99 ※2	14	0	5,800	2,000

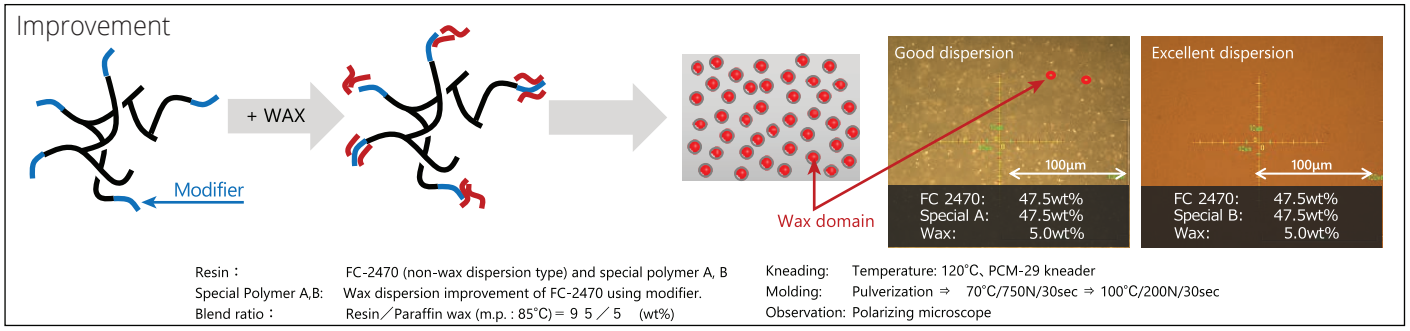
DIACRON™ Product Line | New Catalyst

Grade	Resin Design	Tg (℃)	T4 (℃)	A.V. (mgKOH/g)	Gel ※ (wt%)	Mw※	Mn※
FC-2507	Standard	60	130	8	＜10	67,000	2,200
FC-2509	Standard	60	139	9	5～15	102.300	2,100
FC-2579	Wax dis. of FC-2509	60	142	9	5～15	108,800	2,200
FC-2447	High gel	64	161	11	20～25	33,000	2,000
FC-2555	High gel	61	151	9	10～20	58,000	2,200
FC-2754	High gel	64	162	9	15～20	67,500	2,200
FC-2972	Wax dis.	61	146	3	10～15	92,900	2,000
FC-2510	Full color	58	121	8	＜ 5	33,000	2,100
FC-2799	Full color	61	120	8	＜ 5	75,500	2,100
FC-2902	Wax dis.	55	123	4	＜ 5	270,000	2,100
FC-2470	Low viscosity	54	104	10	0	5,700	1,500
FC-2442	Wax dis. of FC-2470	52	100	11	0	5,200	1,400
FC-2656	Low viscosity	60	110	18	0	5,000	1,800
FC-2730	Wax dispersion of ER-561	57	99 ※2	14	0	5,700	2,000
FC-2784	Low viscosity	53	93 ※2	9	0	4,400	1,500
FC-2798	Low viscosity	60	106	8	0	4,800	1,700
FC-2897	Wax dis.	53	99	11	0	5,500	1,800

Wax Dispersion Technology

With the addition of specialty modifiers, DIACRON® toner resins can control wax dispersion.





Resin： FC-2470 (non-wax dispersion type) and special polymer A, B
Special Polymer A,B: Wax dispersion improvement of FC-2470 using modifier.
Blend ratio： Resin／Paraffin wax (m.p. : 85℃) = 9 5 ／ 5 (wt%)

Kneading: Temperature: 120℃、PCM-29 kneader
Molding: Pulverization ⇒ 70℃/750N/30sec ⇒ 100℃/200N/30sec
Observation: Polarizing microscope