



Probiotic[®] SOLUTIONS

Wastewater: A Hidden Opportunity?

Presented by

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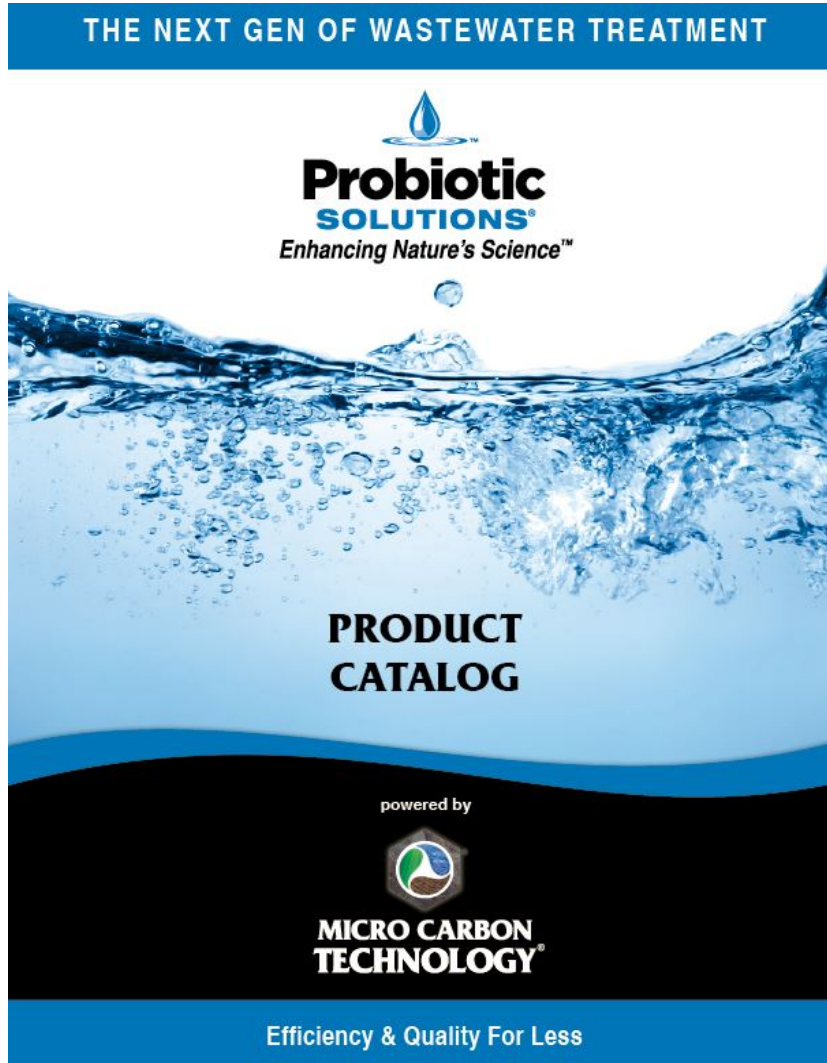
Senior Director of Probiotic Solutions

Markets We Serve:

- Municipal Wastewater
- Industrial Wastewater
- Livestock Waste Management
- Soil Remediation
- Aquaculture
- Septic Systems
- Groundwater Remediation

Industries Serviced

- Activated Sludge and Lagoons
 - Municipal
 - Industrial/Petro-chemical/Pulp & Paper
 - Food Processing (fruit, vegetable, and animal)
 - Aquaculture
 - Livestock Waste Management
- Soil Remediation
 - Hydrocarbon Contamination



- English
- Spanish

- Bio Stimulants
 - Bio Energizer[®], Bio Genesis[®], Encapsalt[®], Kleenup[™], Liquidator[®], Micatrol[®], Bio Genesis[®] II, Phyto-Max[™], Septicure[®]
- Nutrients
 - Super Phos[™], Super Nitro[®], Max-Pak[®], Nutriplex[®]
- Carbon Source
 - Fulvi Pro[®], Huma Pro[®], Huma Burst[®], and X-Tend[®]
- Bio Augmentation (10 in all)
 - Microplex[™]-HC, Microplex[™]-HS, Microplex[™]-FL

Product Applications

- Municipal
 - Lagoons: Bio Energizer[®]
 - Activated Sludge: Bio Genesis[®], Bio Energizer[®], Micatrol[®]
- Industrial
 - Activated Sludge: Bio Genesis[®], Bio Energizer[®], Micatrol[®]

Product Applications (Cont'd)

- Food Processing
 - Lagoons: Bio Energizer[®]
 - Activated Sludge: Bio Genesis[®], Bio Energizer[®], Micatrol[®]
- Aquaculture
 - Ponds/Tanks: Phyto-Max[™], Bio Dredge[®], Super Phos[®], Max Pak[®]
- Livestock Waste Management
 - Lagoons: Liquidator[®], Microplex[™]-FL

Product Applications (Cont'd)

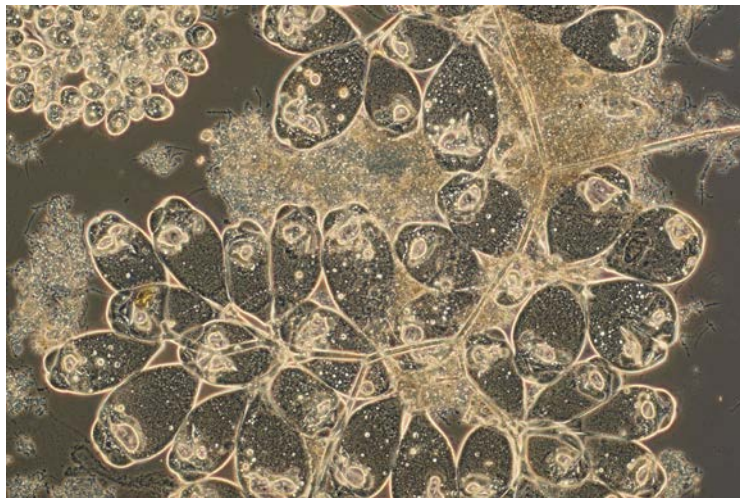
- Soil Remediation
 - Biostimulant: Bio Energizer[®]
 - BioBuffer: Micatrol[®]
 - Macro- and Micronutrient: Nutriplex[®] & Max Pak[®]
 - Microorganisms: Microplex[™]-HC and -HCD
- Additional products on case-by-case basis
 - Bio Genesis[®], Encapsalt[®], Kleenup[™]

Why Our Products Work

- Stimulate existing bacteria
- Buffer microbial communities
- Bioavailable nutrients

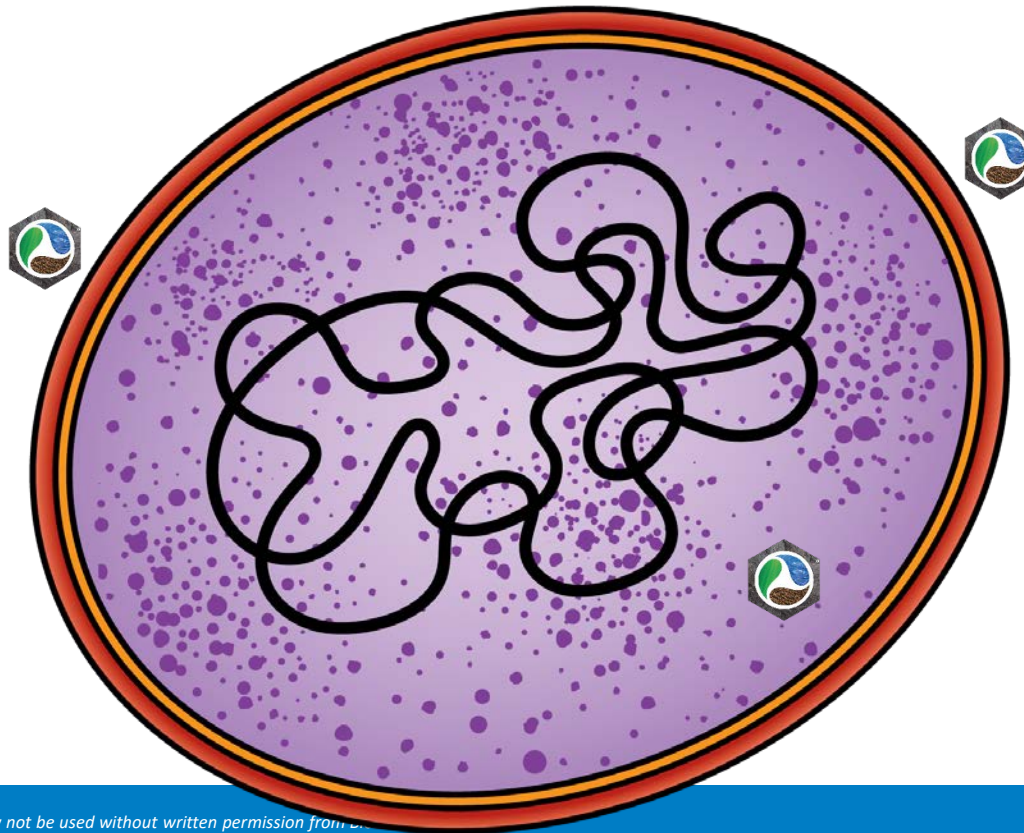
Microbial Needs

- Macro- and micronutrient availability allows for system stability, which leads to higher microbial life forms
 - amoebas, free and stalked ciliates, rotifers, other protazoa
- Lack of higher life forms is an indicator of toxicity, lack of nutrients, and can lead to filamentous bacteria and sludge build-up



Microbial Support Via Micro Carbon Technology®

- MCT increases bioavailability of macro- and micronutrients.
- Stimulates a broader mix of microbial life forms.
- Increases system operational stability.



Case Studies

- Municipal
- Food Processing
- Pulp & Paper
- Soil Remediation

Activated Sludge Plant – Bio Genesis®

Arizona – WWTP dosing goals:

- Reduce sludge wasting
- Improve DO levels
- Lower power consumption

Facility Flow – 8 MGD (30,300 m³)

Current Results:

- **Eliminated foam**
- **Lowered power consumption**
- **Lowered disinfection chemical usage**
- **Improved SVI**
- **Concentrated treatment (3 units)**

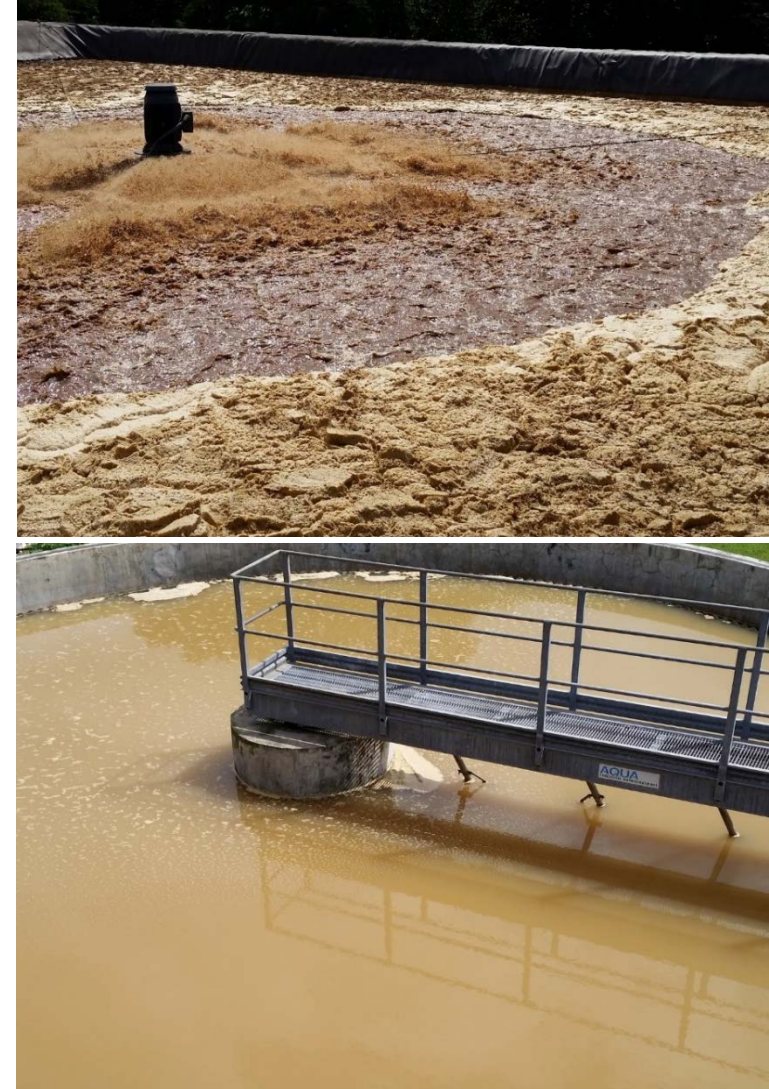


Activated Sludge Plant – Bio Energizer®

Panama

Within 2 weeks of application these are the following results (during high loading):

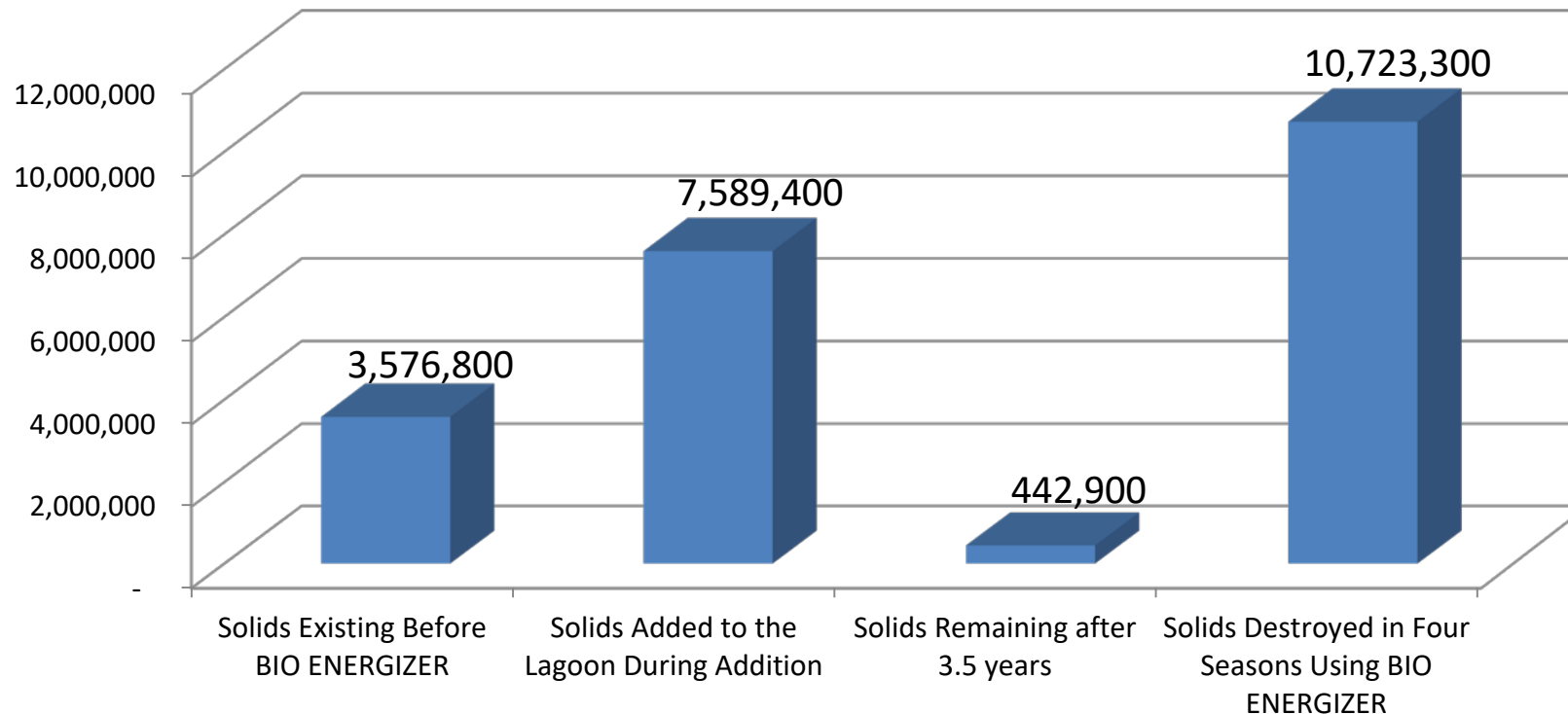
- **Elimination of offensive odors**
- **Microbial activity greatly increased**
- **95% foam reduction in clarifier**
- **35% foam reduction in aerated stabilization basin**
- **Improved BOD reduction**



Vegetable Processing Lagoon – Bio Energizer®

Illinois—Four Seasons

- 9 million cases of peas, corn, carrots, and lima beans per season
- Average 130 packing days
- 750,000 gpd of wastewater, Average BOD 6,500 mg/L
- 10 million pounds of vegetable sludge removed



Municipal Lagoon— Bio Energizer®

California—Municipal wastewater that receives dairy/cheese processing wastewater.

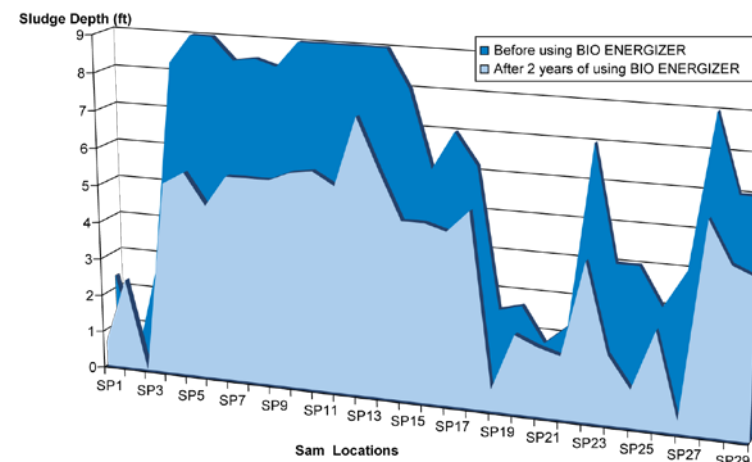
- Surface sludge average depth 6 ft (1.8 m).
- Lost Capacity
- Dredging cost
 - \$341 per dry ton
 - Estimated 3,502 dry tons
 - Removal cost = \$1,194,000

BIO ENERGIZER® for 2 years

- **Removed 1,268 dry tons, as well as treated incoming solids**
- **Average depth of 3.82 ft (1.2 m)**



**Pond #2 Sludge Blanket Profile
Over a 2 Year Period Using BIO ENERGIZER®**



Abattoir Lagoon AU— Bio Energizer®

Australia – Bioremediation of lagoon sludge, 95% Full

- **Treatment Lagoon lost to sludge accumulation – offline in 2013**
- **Approximately 4.5 ft (1.3 m) of sludge removed from extent of lagoon.**
- **Regained treatment capacity**
- **Improved irrigation water quality**



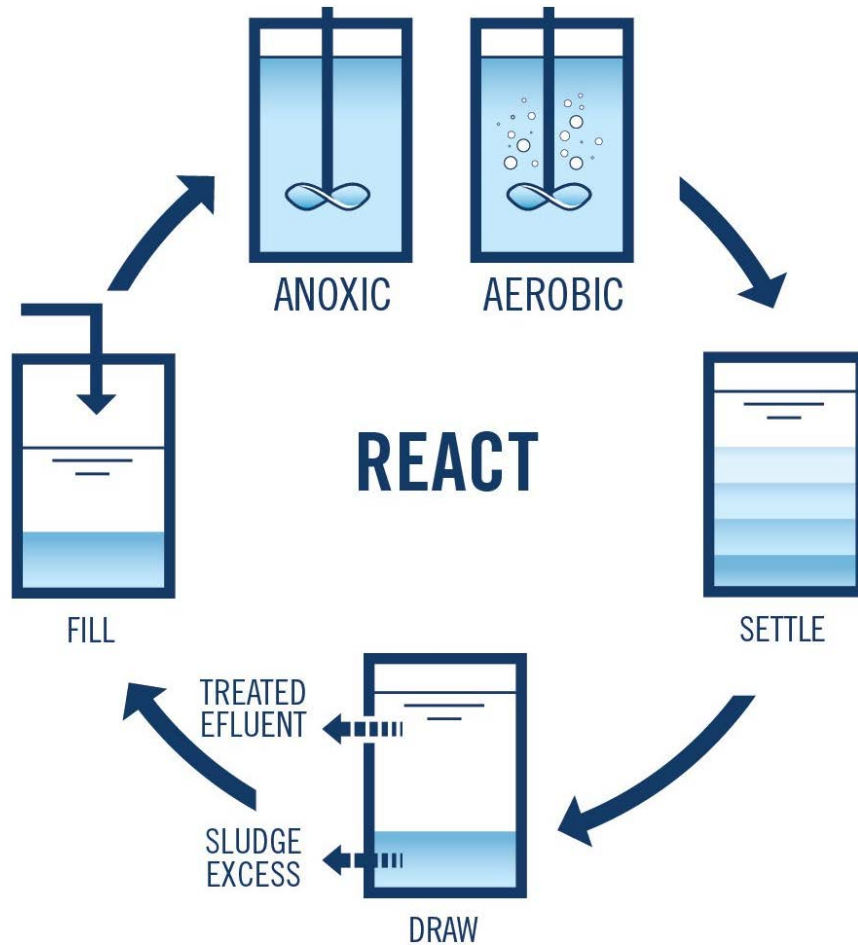
Palm Oil—Bio Energizer®

Panama – Bioremediation of three lagoons full of solids

- **30-Day treatment period**
- **BOD removal improved over 40%**
- **Floating material removed**
- **Sludge breaking up**



Pulp and Paper—Super Phos[®]



A preliminary pilot study was performed at Mill 2.

FACILITY TYPE:

- Aerobic sequencing batch reactor (SBR) wastewater system
- Treats 50,000 m³/day
- Uses one tank for the entire treatment process

Pulp and Paper—Super Phos®

- Over a period of 7 days, Phosphorus Acid was incrementally replaced at a rate of 25% and optimized
- **Phosphorus Acid usage was reduced by 75%** while maintaining greater than 80% reduction of COD—final results below

Index	#3 SBR Tank	#4 SBR Tank
COD Removal Rate	84%	81%
Avg. MLSS	1941 mg/L	1949 mg/L
Avg. SV30	72	73

Crude Oil in Texas

- Soil from several oil recovery storage tank batteries was removed
 - Soil was stored on-site for 5 years with periodic soil additions
 - Indigenous microbial populations deemed sufficient for remediation
- Initial composite sample collected and analyzed per EPA methodologies
 - TPH 75,000 ppm
 - Barium 1,750 ppm
 - Cadmium 0.4 ppm
 - Chromium 7.5 ppm
 - Mercury 0.1 ppm
 - Lead 49.9 ppm

Crude Oil in Texas (Cont'd)

- Soil moisture (30%) was maintained and the soil periodically mixed.
- Approximately 2 weeks later, three products were applied (Bio Energizer[®], Nutriplex[®] and Micatrol[®]) via 3,000 gallons of water.
 - Water was added and the soil mixed periodically to maintain moisture and aeration.

Crude Oil in Texas

Results

- Final Sampling results
 - TPH was reduced from 75,000 ppm to 10,000 ppm, 87% reduction
 - During treatment, the contaminated material's coloring changed from a black or dark-gray to a brown to light brown color

- How we help you sell
 - Site Visits
 - Engineering Support
 - Help tracking data for systems
 - Dosing recommendations
 - Troubleshooting
 - Presentations to local authorities, select conferences
 - Catalogs and brochures

What We've Been Up To (Cont'd)

- Presentations at International Conferences
 - Pulp and Paper
 - WEFTEC
 - IPPE
 - TAPPI-PEERS
- Articles Published

Wastewater Nutrient Changes Lead to Savings for Mill Owners (Shawn Whitmer and Heather Jennings)	<i>Pulp & Paper International</i> (July/August 2015 issue)
Micro Carbon Technology®: A Powerful and Proven Technology to Improve Wastewater Treatment Efficiency (Shawn Whitmer and Heather Jennings)	TAPPI-PEERS Conference, October 2015
Use of Biostimulants and Buffers for Upset Recovery in Paper Mill Wastewater Systems (Shawn Whitmer, PE; Heather Jennings, PE; Zou Xuesheng; Xiao Peng; Jiang Ganfu; Sun Yinyi; and Hu Chong)	<i>International Water and Waste Management</i> (Nov. 2015 issue)

Emerging Market Countries

- Countries
 - Canada
 - Spain
 - Chile
 - Panama
 - Ecuador
 - Colombia

Is this
something
for your
Company?



Probiotic[®] SOLUTIONS

Thank You

Publication No. PS-161011-01