HydRegen

‘Slot-in’ biotechnology for more sustainable chemical production

Product Guide

Bio2Amine™

We make biology operate like chemistry.

“Chemistry for biology”

About Us

We are **redefining chemical manufacturing**, bringing together the **elegance of biology** and **intensification of modern chemistry**.

Our products allow you to:

- ✓ **replace your heavy-metal** catalyst for hydrogenation reactions, or
- ✓ **decarbonise your existing biocatalysis** processes
- ✓ within **existing infrastructure**

Our Products:

Product Range	Formula*	Application
Bio2Amine™	Hyd/C	Nitro-group reduction to amine
H_2BioCat: NADH-Regen	Hyd/C/E	NAD(H) co-factor recycling; Asymmetric double bond reductions;
H_2BioCat: Flav-Regen	Hyd/E	Flavin co-factor recycling

*Hyd = HydRegen biocatalyst formulation; /C = on-carbon; E = Bespoke cofactor-dependent enzyme

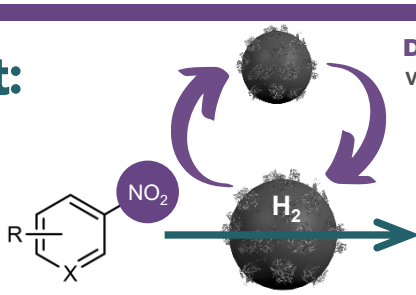
Bio2Amine™ Catalyst:

Carbon-supported biocatalyst system for clean aromatic amine production *via* nitro group reduction

- Complete reduction to amine
- Uses established hydrogenation protocols
- No additives or cofactors necessary (compatible with a range of these if preferred)
- Broad substrate scope
- Proven chemoselectivity
- Multi-day catalyst stability

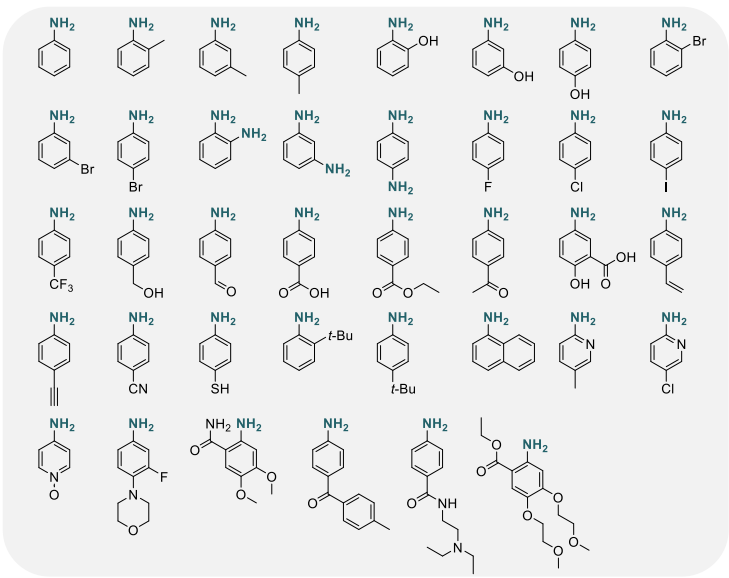
Catalyst evaluation samples

- High hit rate
- Designed for 10 mL 3-5 g/L reactions
- Operate in typical benchtop hydrogenation setups
- HydRegen offer joint development for intensification and scale-up



Demonstrated catalyst re-use, with up to **15 re-use cycles** and **>3 million** total turnovers in a **batch** set-up

>99 % conversion of **>35** substrates



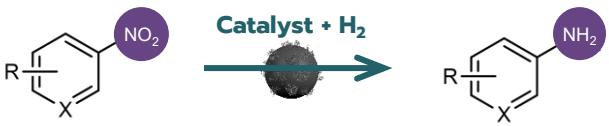
Bio2Amine™ Product Guide

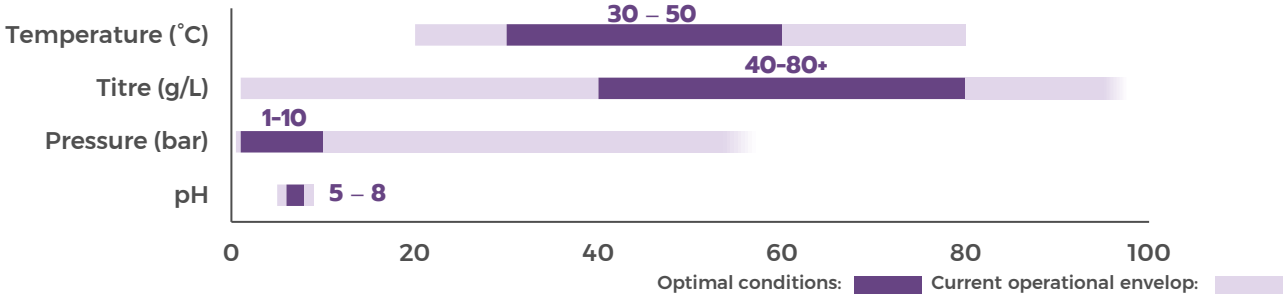
Bio2Amine™ is a biocatalytic hydrogenation catalyst with similar handling to common M/C-type catalysts. Using HydRegen technology to provide **industrial reactions under mild conditions** we are:

- ✓ **lowering energy requirements**
- ✓ **improving specificity**
- ✓ **simplifying downstream processing**

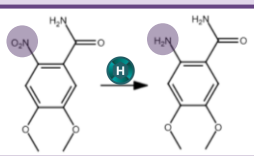
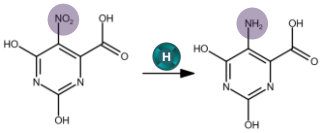
Bio2Amine™ is recommended for **nitro-group reductions**.

Bio2Amine™ Optimal Operating Conditions:





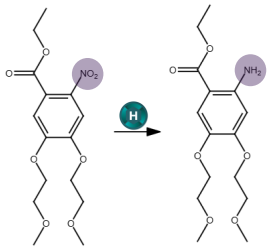
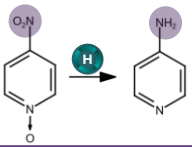
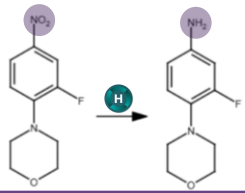
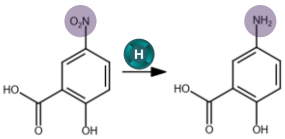
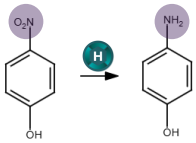
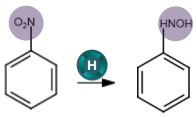
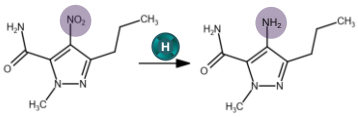
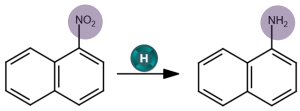
Example Reactions:

Product	Reaction	Temp (°C)		Co-solvents		Carbon mesh sizes			Mode		Titre (g/L)	
		15-40	40+	Miscible	Immiscible	nano	milli	macro	Batch	Continuous	0-50	51+
APIs / Precursors												
Alfuzosin (intermediate)		○	●	●	○	●	○	○	●	○	●	○
Dipyridamole (intermediate)		○	●	●	○	●	○	○	●	○	●	○

Optimal operating conditions: ■ Current operational envelope: □

Bio2Amine™ Product Guide

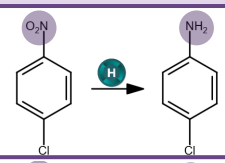
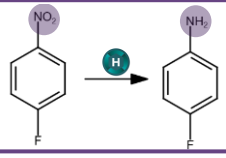
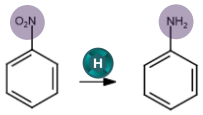
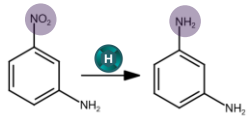
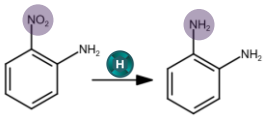
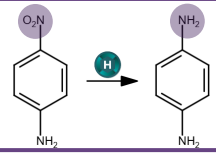
Example Reactions:

Product	Reaction	Temp (°C)		Co-solvents		Carbon mesh sizes			Mode		Titre (g/L)	
		15-40	40+	Miscible	Immiscible	nano	milli	macro	Batch	Continuous	0-50	51+
APIs / Precursors												
Erlotinib (intermediate)		○	●	●	●	●	○	○	●	○	●	○
Fampridine		●	●	●	○	●	○	○	●	○	●	○
Linezolid (intermediate)		○	●	○	●	●	○	○	●	○	●	○
Mesalazine		●	●	●	○	●	●	●	●	●	●	●
Paracetamol (intermediate)		●	●	●	○	●	●	●	●	●	●	●
Paracetamol (intermediate)		●	●	●	○	●	○	○	●	○	●	○
Sildenafil (intermediate)		○	●	●	●	●	○	○	●	○	●	○
Specialty / Bulk Chemical												
1-Naphthylamine		○	●	○	●	●	○	○	●	○	●	○

Optimal operating conditions: ■ Current operational envelope: □

Bio2Amine™ Product Guide

Example Reactions:

Product	Reaction	Temp (°C)		Co-solvents		Carbon mesh sizes			Mode		Titre (g/L)	
		15-40	40+	Miscible	Immiscible	nano	milli	macro	Batch	Continuous	0-50	51+
Specialty / Bulk Chemical												
4-Chloroaniline		○	●	○	●	●	○	○	●	○	●	○
4-Fluoroaniline		○	●	○	●	●	○	○	●	○	●	●
Aniline		●	○	●	●	●	○	○	●	○	●	○
m-Phenylenediamine		○	●	●	●	●	○	○	●	○	●	○
o-Phenylenediamine		○	●	●	●	●	○	○	●	○	●	○
p-Phenylenediamine (PPD)		○	●	○	●	●	○	○	●	○	●	○

Optimal operating conditions: ■ Current operational envelope: □

For more products, bespoke processes and intensification...

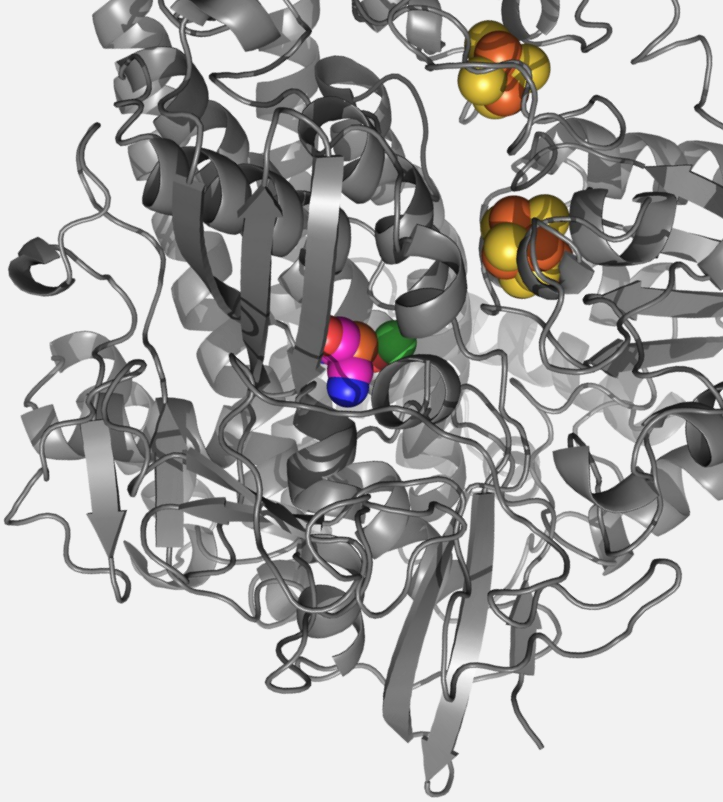
E: Products@hydregenoxford.com

HydRegen

Begbroke Science Park, Oxford,
OX5 1PF, U.K.

W: https://hydregenoxford.com

E: products@hydregenoxford.com



For more information get in touch

E: Products@hydregenoxford.com

We make biology operate like chemistry.

"Chemistry for biology"

HydRegen

‘Next generation chemical manufacturing’

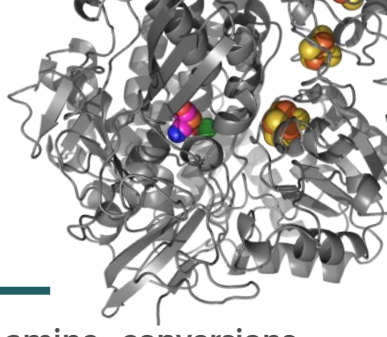
Technical Information Sheets

We make biology operate like chemistry.

“Chemistry for biology”

Bio2Amine™ for Alfuzosin

"Next generation chemical manufacturing"

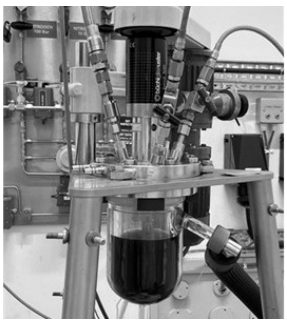


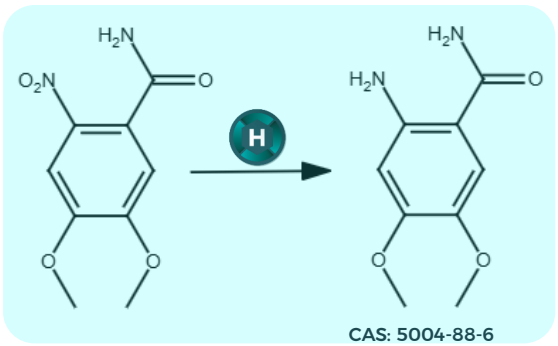
2-amino-4,5-dimethoxybenzamide

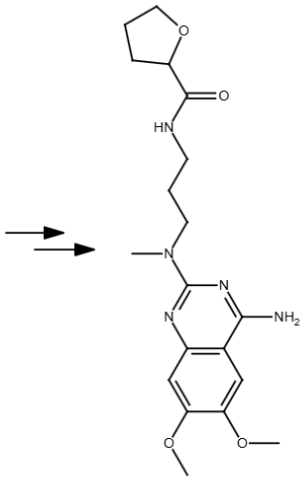
Precursor for pharmaceutical alfuzosin

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 3,4-dimethoxy-6-nitrobenzamide, Bio2Amine™ facilitates highly selective hydrogenation to 2-amino-4,5-dimethoxybenzamide with no observable intermediates or side products. The catalyst shows selectivity over the unsaturated amide functionality.





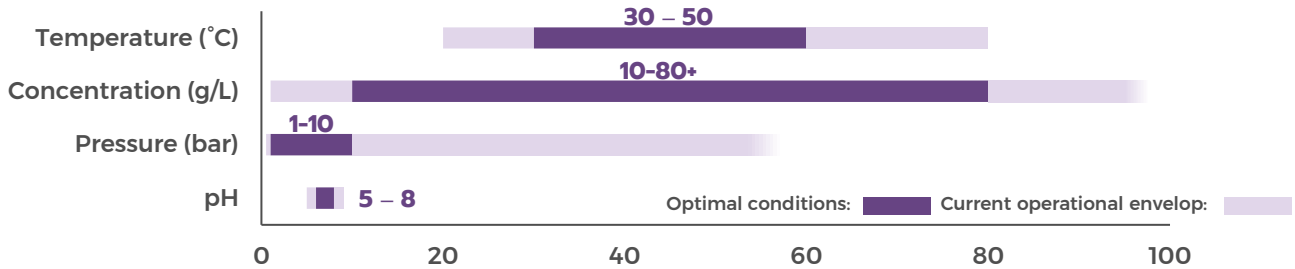


API

Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 20 g/L

Solvents: ≤ 50 % miscible organic solvent in water

Miscible solvents:	NMP	MeCN
	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

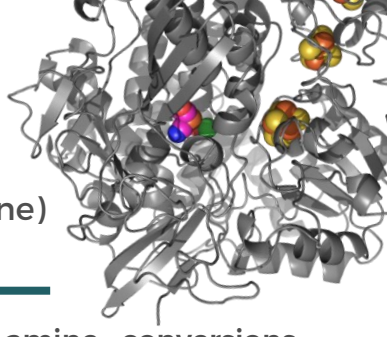
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Dipyridamole

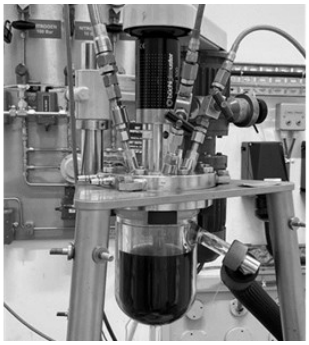
"Next generation chemical manufacturing"

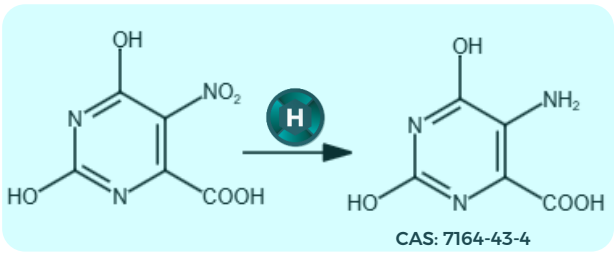


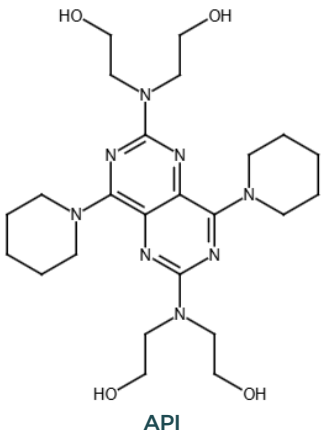
5-Aminoorotic acid (5-Amino-6-carboxy-2,4-dihydroxypyrimidine)
Precursor for pharmaceutical dipyridamole

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 5-nitroorotic acid, Bio2Amine™ facilitates highly selective hydrogenation to 5-aminoorotic acid with no observable intermediates or side products. This demonstrates compatibility of Bio2Amine™ with a pyrimidine backbone.





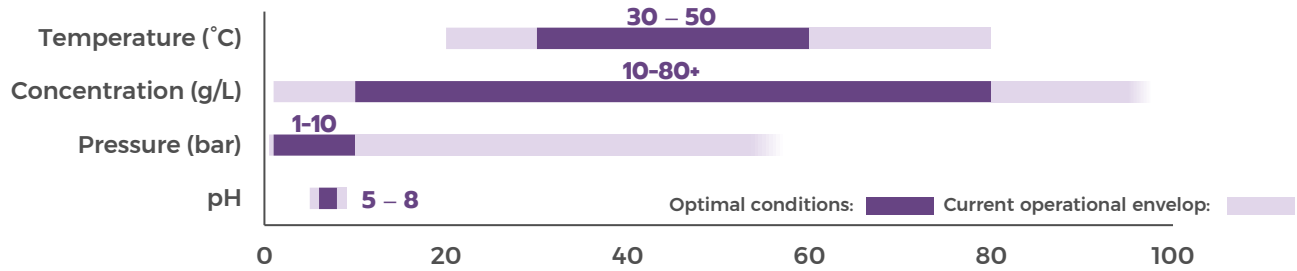


API

Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 40 g/L

Solvents: None, or ≤ 50 % miscible organic solvent in water

Miscible solvents:	NMP	DMSO
	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

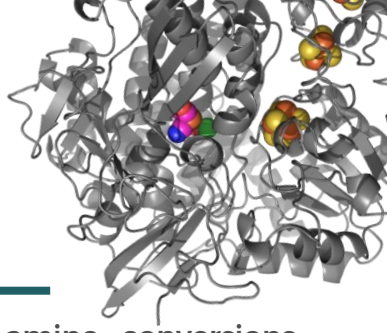
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Erlotinib

"Next generation chemical manufacturing"

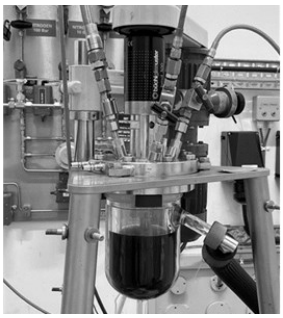


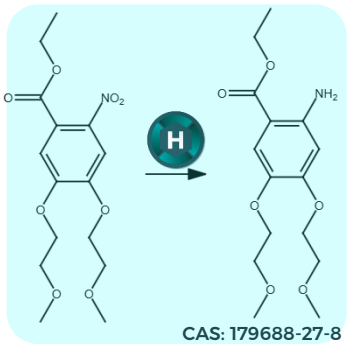
Ethyl-2-amino-4,5-bis(2-methoxyethoxy)benzoate

Precursor for pharmaceutical erlotinib

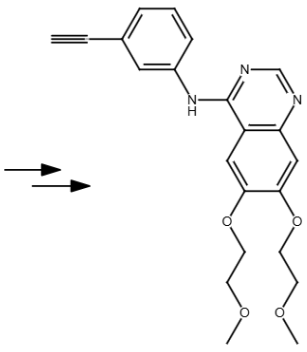
Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of ethyl-4,5-bis(2-methoxyethoxy)-2-nitrobenzoate, Bio2Amine™ facilitates highly selective hydrogenation to ethyl-2-amino-4,5-bis(2-methoxyethoxy)benzoate with no observable intermediates or side products despite the bulky substituted structure and unsaturated ester.





CAS: 179688-27-8

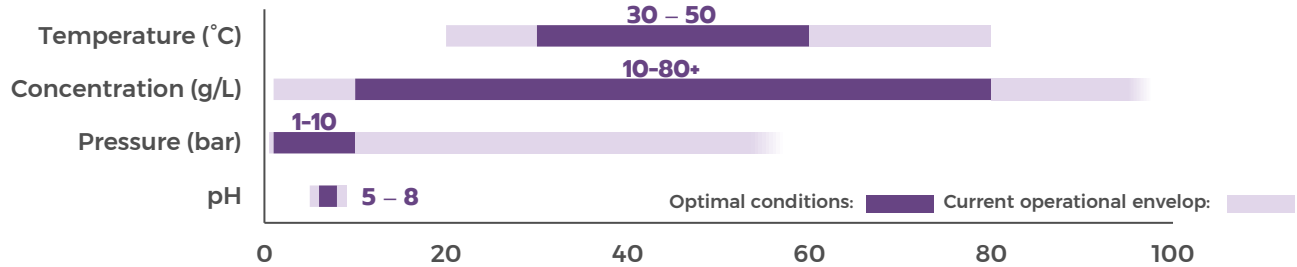


API

Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 20 g/L

Solvents: ≤ 25 % miscible organic solvent in water

Miscible solvents:	NMP	DMSO	DMF	Immiscible solvents
✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

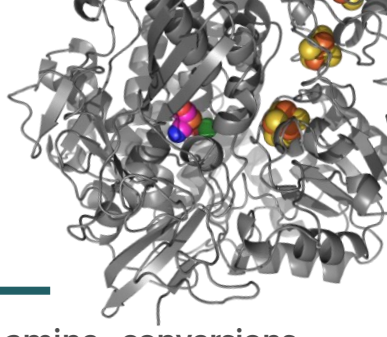
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Fampridine

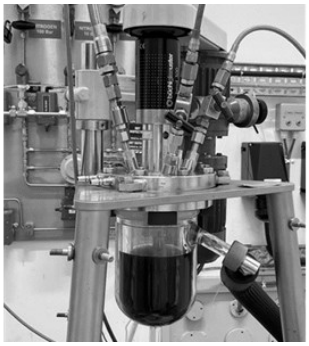
"Next generation chemical manufacturing"

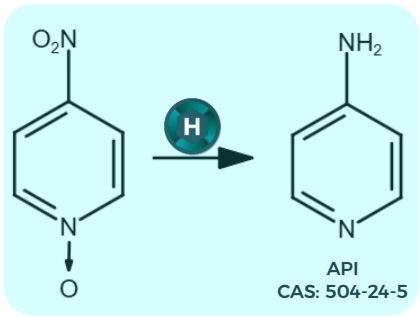


4-Aminopyridine (4-AP, fampridine, dalfampridine)
Pharmaceutical indicated for multiple sclerosis

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

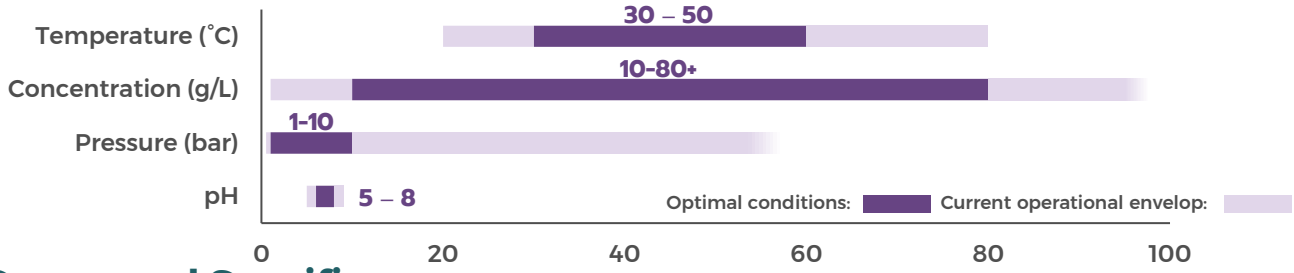
For the reduction of 4-nitropyridine-N-oxide, Bio2Amine™ facilitates highly selective hydrogenation to 4-aminopyridine with no observable intermediates or side products. This demonstrates extension of the Bio2Amine catalyst to pyridine-type scaffolds.





Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous
Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L
Solvents: ≤ 30 % miscible organic solvent in water

Miscible solvents:	MeCN	EtOH	DMF	iPrOH
	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

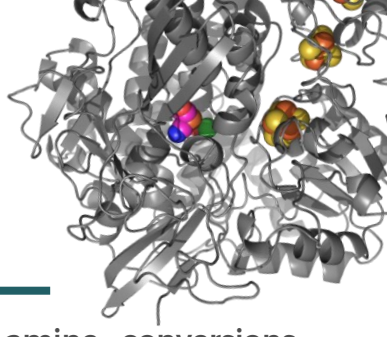
- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

HydRegen

For evaluation samples, email **products@hydregenoxford.com**
For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Linezolid

"Next generation chemical manufacturing"

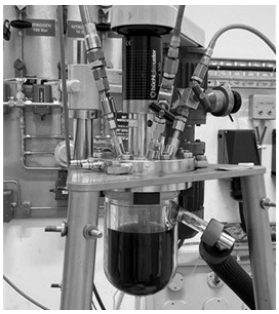


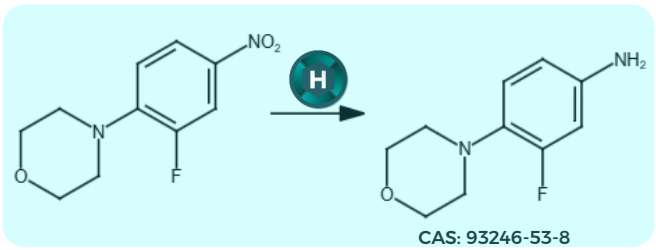
3-fluoro-4-morpholin-aniline

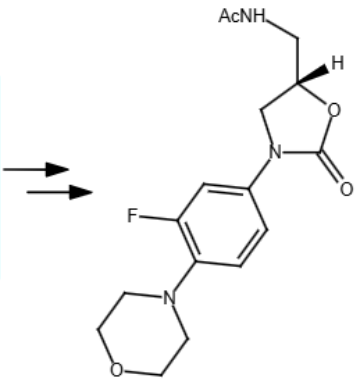
Precursor for pharmaceutical linezolid

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 4-(2-Fluoro-4-nitrophenyl)morpholine, Bio2Amine™ facilitates highly selective hydrogenation to 3-fluoro-4-morpholin-aniline with no observable intermediates or side products, including no dehalogenation.





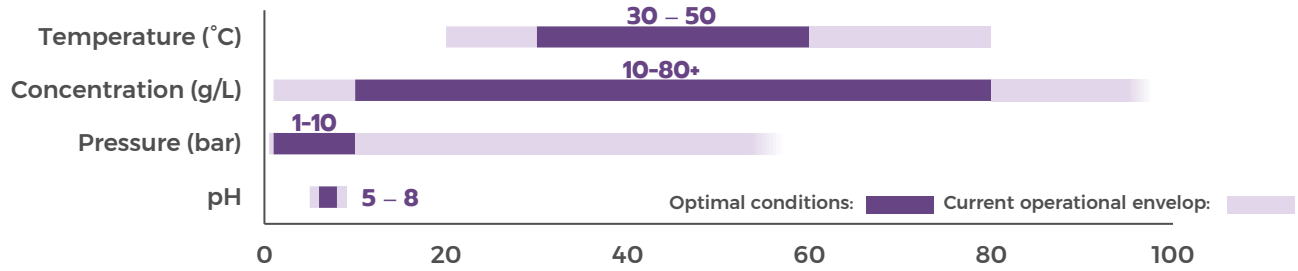


API

Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L

Solvents: ≤ 50 % miscible organic solvent in water

Miscible solvents:	NMP	DMSO	Immiscible solvents
✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

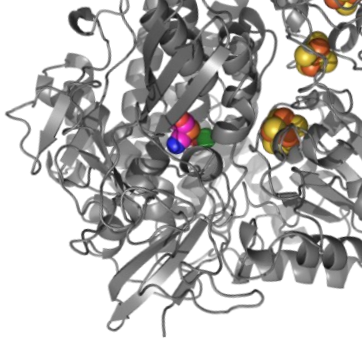
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Mesalazine

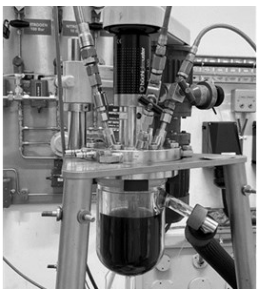
"Next generation chemical manufacturing"

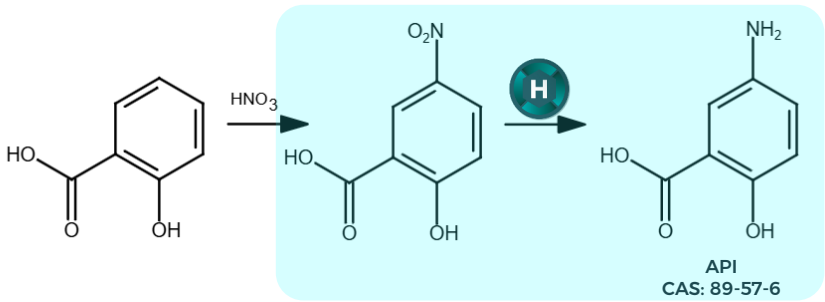


Mesalazine (mesalamine, 5-aminosalicylic acid)
Pharmaceutical indicated for ulcerative colitis, Crohn's disease, inflammatory bowel disease

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 5-nitrosalicylic acid (5-NSA), Bio2Amine™ facilitates highly selective hydrogenation to 5-aminosalicylic acid with no observable intermediates or side products. Following reaction completion, the heterogeneous biocatalyst is easily separated for streamlined downstream processing.



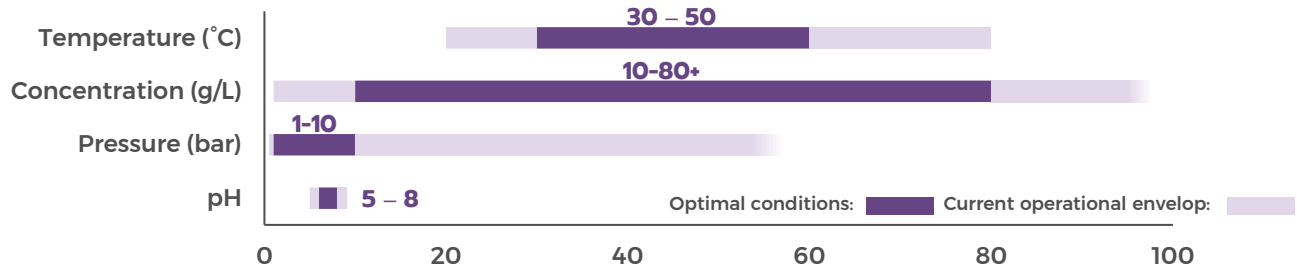


API
CAS: 89-57-6

Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction Concentration: >60 g/L

Solvents: ≤ 40 % miscible organic solvent in water

Miscible solvents:	DMSO	MeOH	MeCN
✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

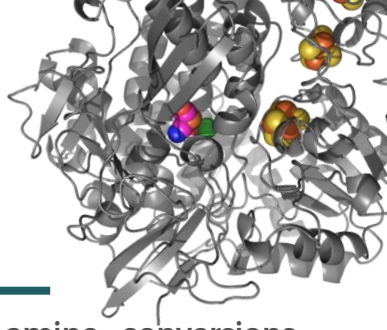
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Paracetamol

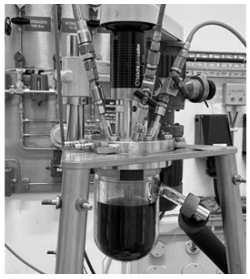
"Next generation chemical manufacturing"

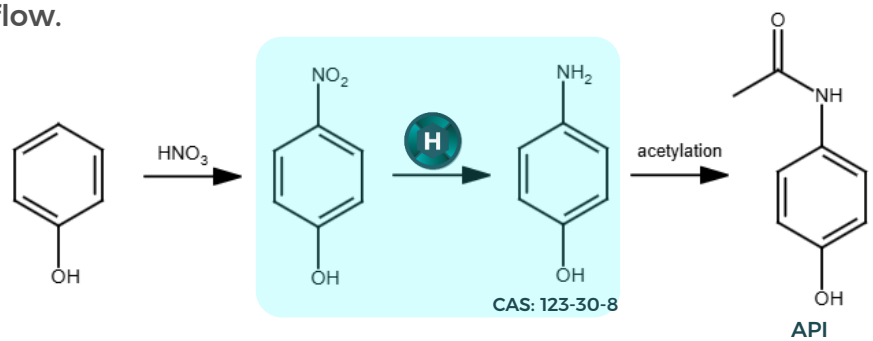


***p*-Aminophenol** (4-aminophenol, 4-hydroxyaminobenzene)
Precursor for paracetamol

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of *p*-nitrophenol (PNP), Bio2Amine™ facilitates highly selective hydrogenation to *p*-aminophenol (PAP) with no observable intermediates or side products. Hydrogenation with Bio2Amine, and subsequent acetylation can both be optimised in continuous flow.

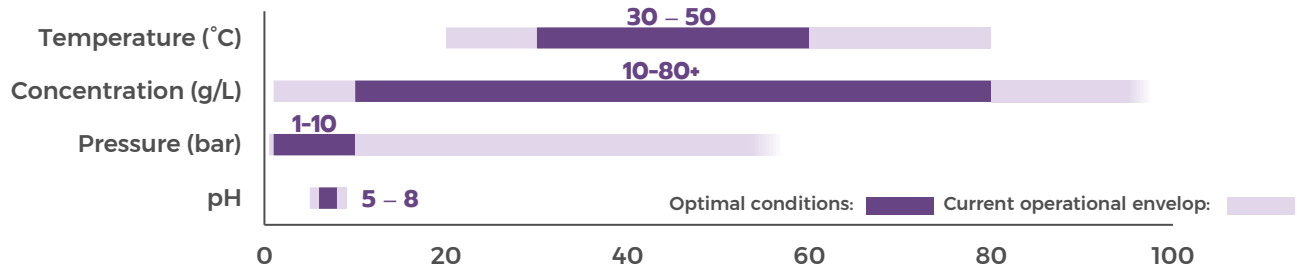




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 75 g/L

Catalyst compatibility: ≤ 50 % miscible organic solvent in water

Miscible solvents:	DMSO	MeOH	DMF	NMP	Acetone	Immiscible solvents
	✓	✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

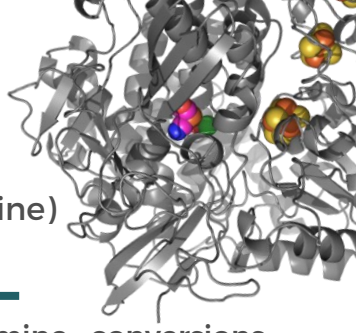
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Paracetamol

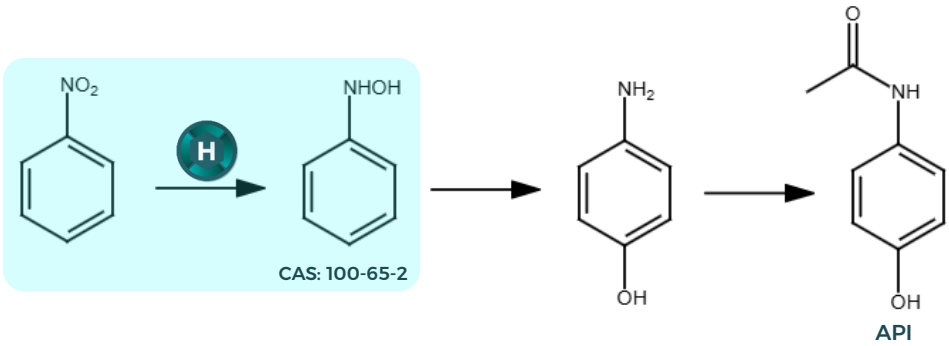
"Next generation chemical manufacturing"



***N*-Phenylhydroxylamine** (*N*-hydroxyaniline,*N*-hydroxybenzenamine)
Precursor for paracetamol

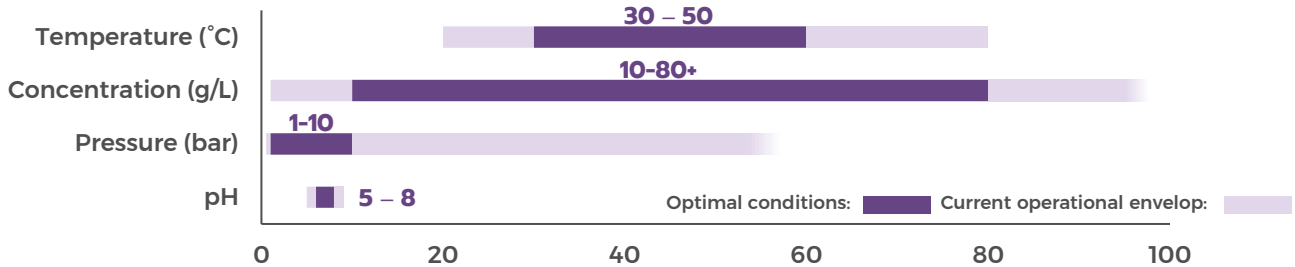
Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of nitrobenzene, Bio2Amine™ facilitates highly selective hydrogenation to *N*-phenylhydroxylamine with no observable intermediates or side products.



Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous
Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L
Solvents: ≤ 25 % miscible organic solvent in water

Miscible solvents:	DMSO	MeOH	DMF	NMP	Acetone	Immiscible solvents
✓	✓	✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

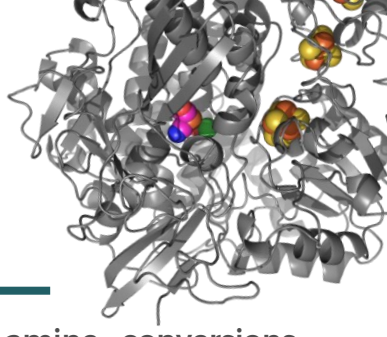
- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

HydRegen

For evaluation samples, email **products@hydregenoxford.com**
For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Sildenafil

"Next generation chemical manufacturing"

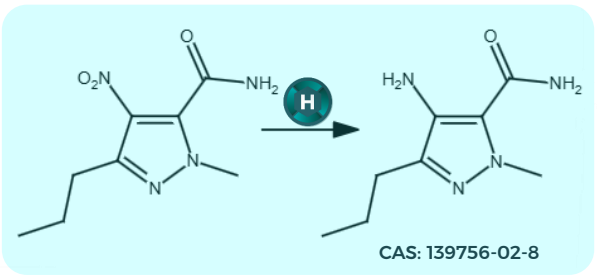


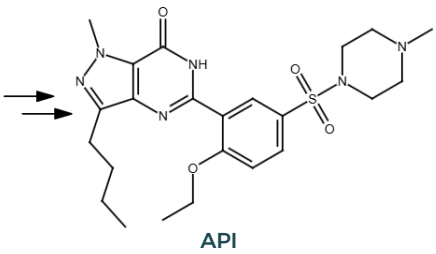
4-Amino-1-methyl-3-*n*-propyl-5-pyrazolecarboxamide

Precursor for pharmaceutical sildenafil

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 1-methyl-4-nitro-3-propyl-(1H)-pyrazole-5-carboxamide, Bio2Amine™ facilitates highly selective hydrogenation to 4-amino-1-methyl-3-*n*-propyl-5-pyrazolecarboxamide with no observable intermediates or side products. This is a key precursor for the blockbuster pharmaceutical sildenafil.

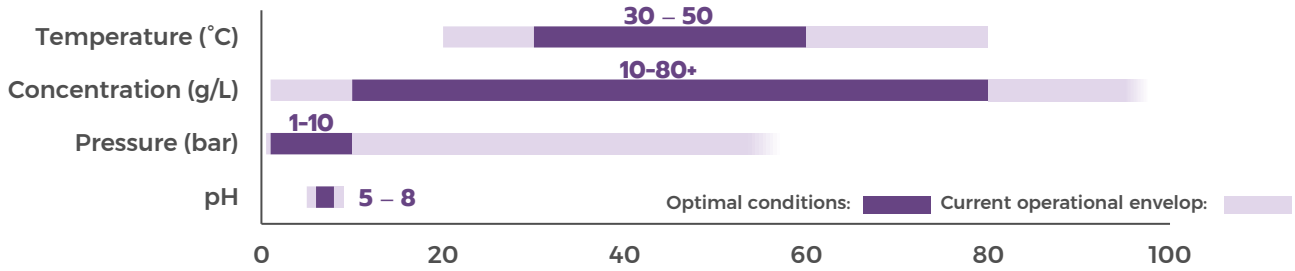




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 40 g/L

Solvents: ≤ 50 % miscible organic solvent in water

Miscible solvents:	DMSO	DMF	NMP	Acetone	Immiscible solvents
✓	✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

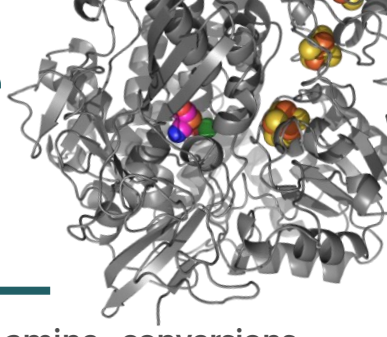
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Naphthylamine

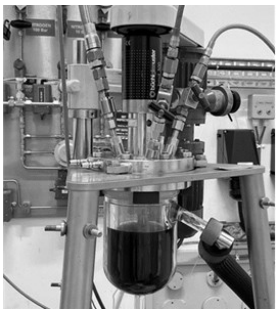
"Next generation chemical manufacturing"

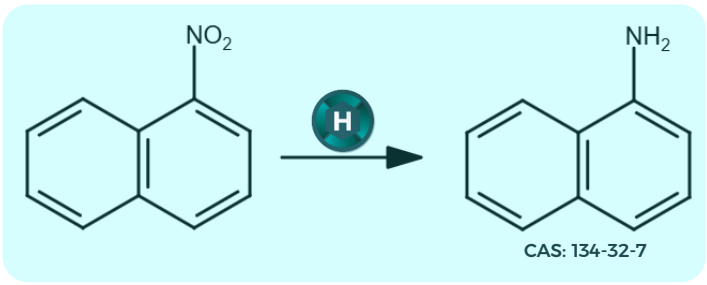


1-Naphthylamine (1-aminonaphthalene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 1-nitronaphthalene, Bio2Amine™ facilitates highly selective hydrogenation to 1-naphthylamine with no observable intermediates or side products, and demonstrating tolerance of bulky, extended aromatic structures.

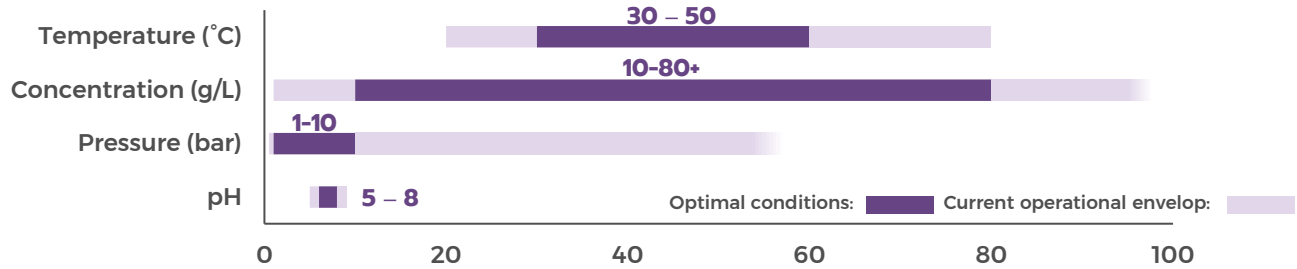




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L

Solvents: Water immiscible organic solvents, water miscible solvents may be used as additives to a biphasic system

Miscible solvents	Immiscible solvents
✓ additive	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

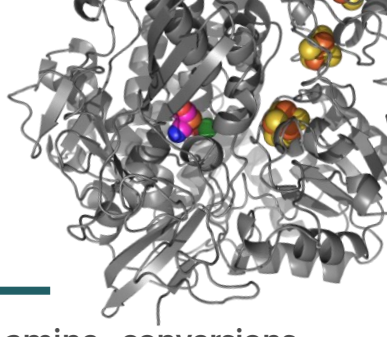
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for 4-Fluoroaniline

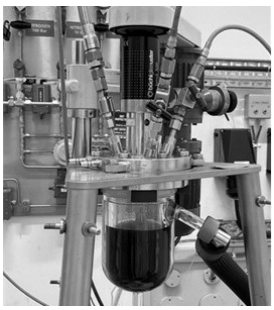
"Next generation chemical manufacturing"

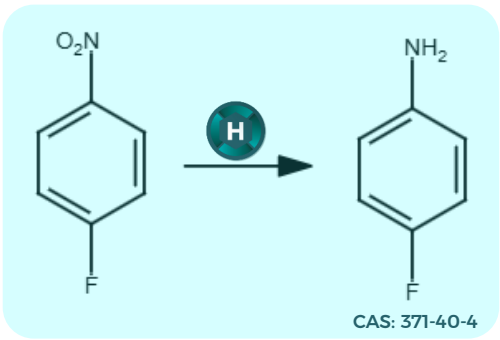


4-Fluoroaniline (1-amino-4-fluorobenzene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 4-fluoronitrobenzene, Bio2Amine™ facilitates highly selective hydrogenation to 4-fluoroaniline with no observable intermediates, side products or dehalogenation.

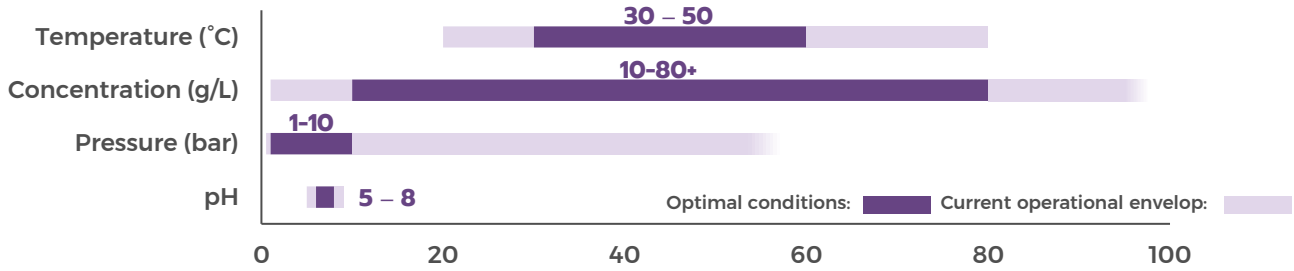




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L

Solvents: ≤ 5 % miscible organic solvent in water

Miscible solvents:	DMSO	DMF	Immiscible solvents
✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

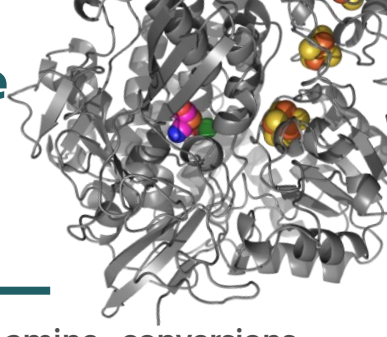
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for 4-Chloroaniline

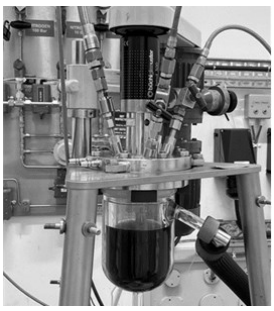
"Next generation chemical manufacturing"

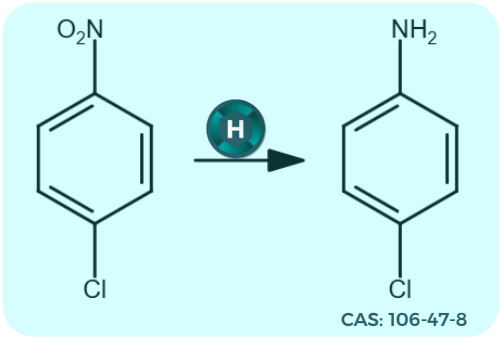


4-Chloroaniline (1-amino-4-chlorobenzene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 4-chloronitrobenzene, Bio2Amine™ facilitates highly selective hydrogenation to 4-chloroaniline with no observable intermediates, side products or dehalogenation.

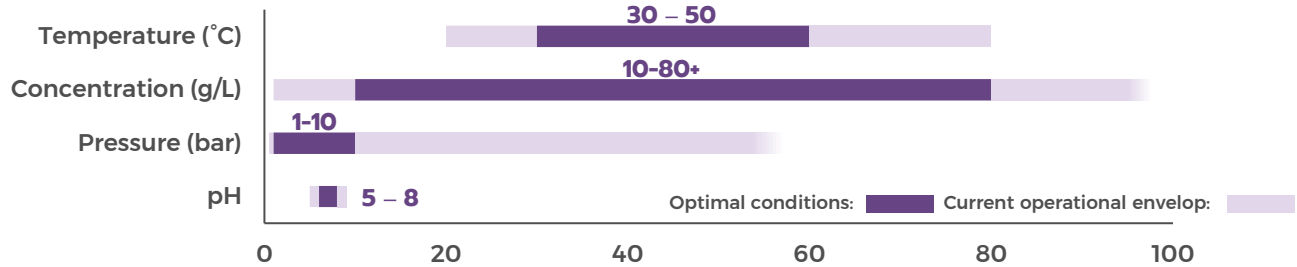




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L

Solvents: Water immiscible organic solvents, water miscible solvents may be used as additives to a biphasic system

Miscible solvents	Immiscible solvents
✓ additive	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

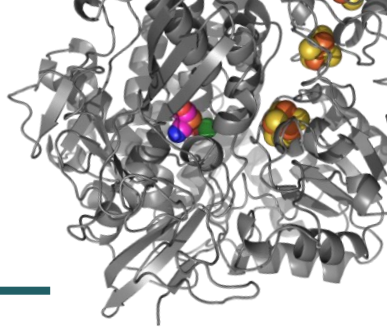
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for Aniline

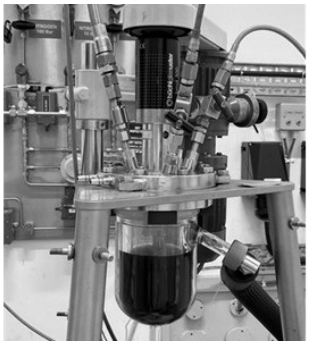
"Next generation chemical manufacturing"

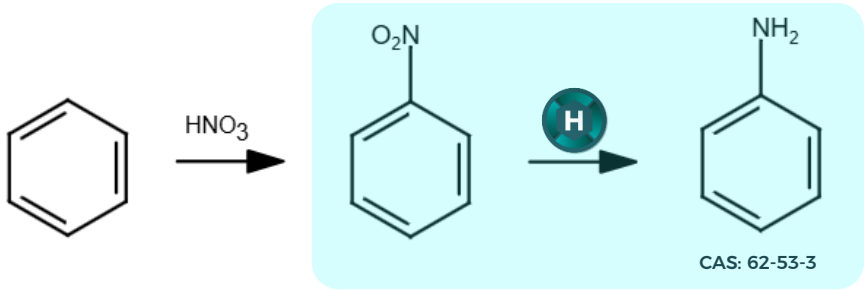


Aniline (aminobenzene, phenylamine)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO_2e saving, and **40** % cost savings

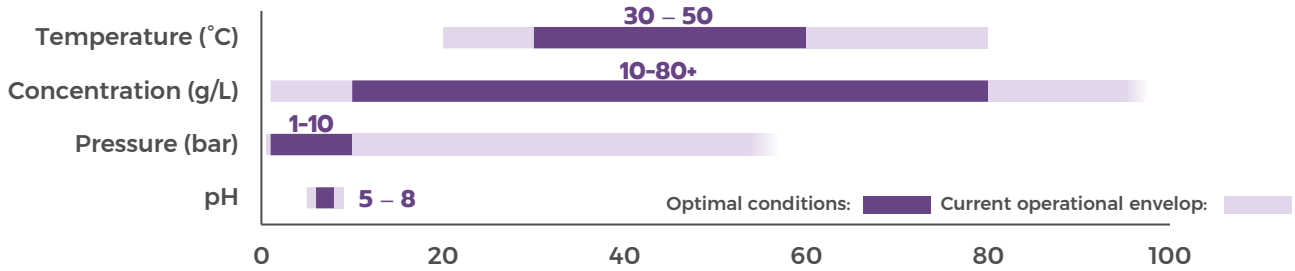
For the reduction of nitrobenzene, Bio2Amine™ facilitates highly selective hydrogenation to aniline with no observable intermediates or side products.





Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous
Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L
Solvents: ≤ 40 % miscible organic solvent in water

Miscible solvents:	DMSO	DMF	MeOH	Acetone	Immiscible solvents
✓	✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

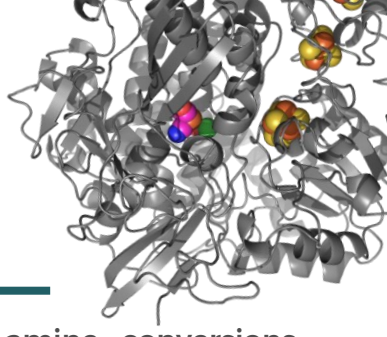
- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

HydRegen

For evaluation samples, email **products@hydregenoxford.com**
For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for MPD

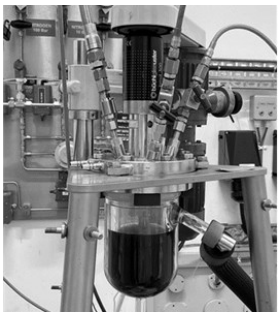
"Next generation chemical manufacturing"

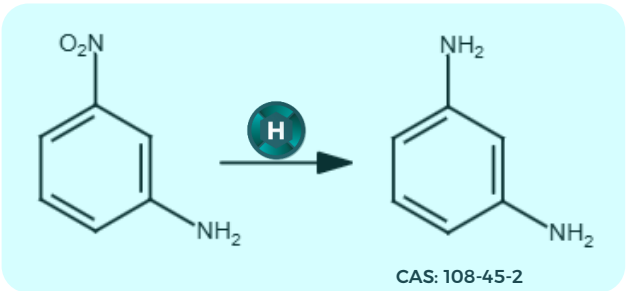


***m*-phenylenediamine** (MPD, 1,3-diaminobenzene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 3-nitroaniline, Bio2Amine™ facilitates highly selective hydrogenation to MPD with no observable intermediates or side products. Additionally, this reaction proceeds with Bio2Amine™ from the di-nitro starting material.

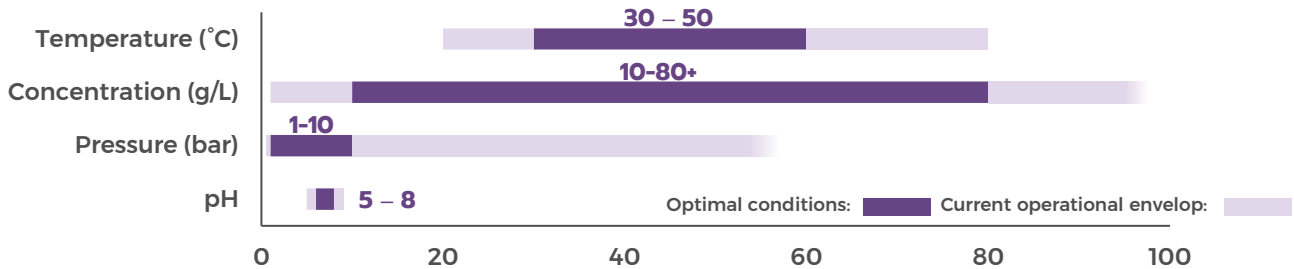




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 27 g/L

Solvents: ≤ 50 % miscible organic solvent

Miscible solvents:	DMSO	DMF	NMP	Immiscible solvents
✓	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

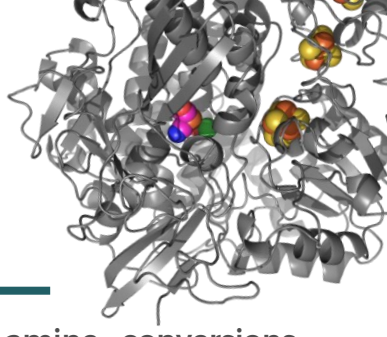
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for OPD

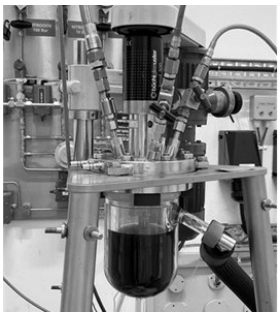
"Next generation chemical manufacturing"

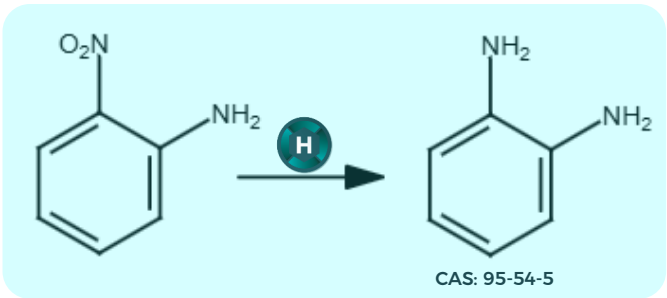


***o*-phenylenediamine** (OPD, 1,2-diaminobenzene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 2-nitroaniline, Bio2Amine™ facilitates highly selective hydrogenation to OPD with no observable intermediates or side products. Additionally, this reaction proceeds with Bio2Amine™ from the di-nitro starting material.

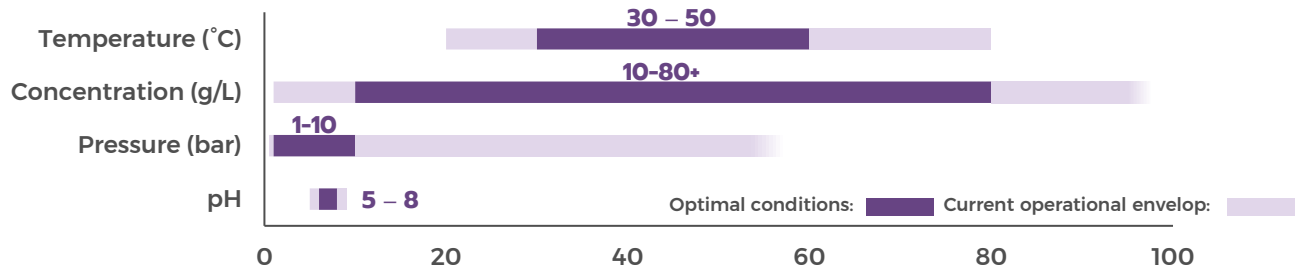




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 40 g/L

Solvents: ≤ 50% miscible organic solvent

Miscible solvents:	DMSO	DMF	NMP	Immiscible solvents
	✓	✓	✓	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

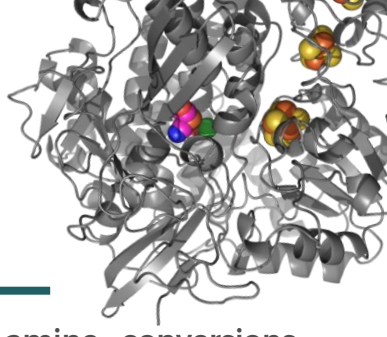
HydRegen

For evaluation samples, email **products@hydregenoxford.com**

For further technical notes, visit **hydregenoxford.com**

Bio2Amine™ for PPD

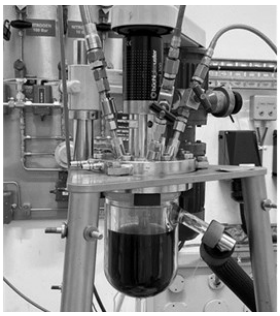
"Next generation chemical manufacturing"

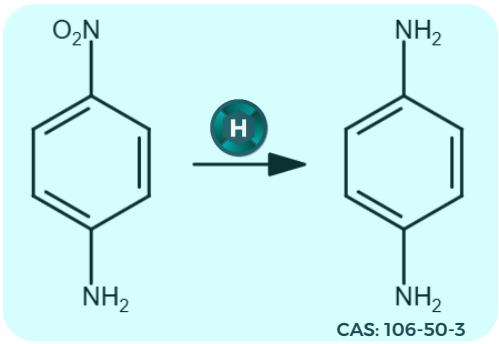


***p*-phenylenediamine** (PPD, 1,4-diaminobenzene)
Specialty / bulk chemical

Replacing metal-catalysts with our bio-alternative for nitro-to-amine conversions provides at least: **3** x CO2e saving, and **40** % cost savings

For the reduction of 4-nitroaniline, Bio2Amine™ facilitates highly selective hydrogenation to PPD with no observable intermediates or side products. Additionally, this reaction proceeds with Bio2Amine™ from the di-nitro starting material.

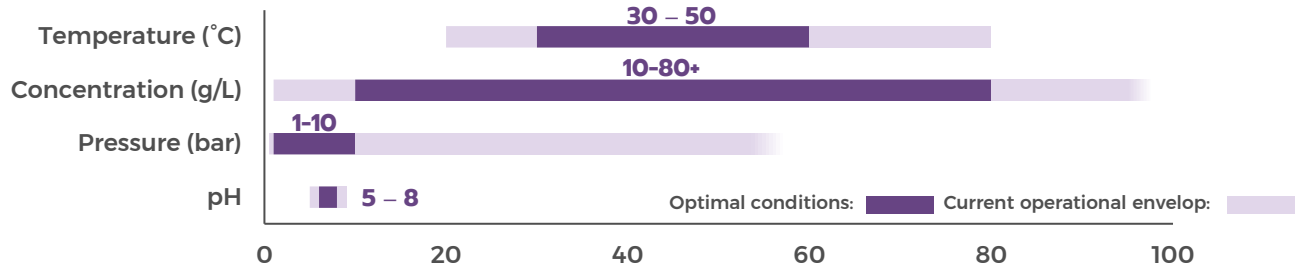




Bio2Amine™ Operating conditions:

Infrastructure: batch, fed-batch, continuous

Operational stability: >4 million enzyme turnovers, >100 hours



Compound Specifics:

Reaction concentration: 50 g/L

Solvents: Water immiscible organic solvents, water miscible solvents may be used as additives to a biphasic system

Miscible solvents	Immiscible solvents
✓ additive	✓

About us:

HydRegen is pioneering a technology, Bio2Amine™, a 'slot-in' biocatalytic alternative to traditional catalysts for nitro-to-amine reduction, removing the need for precious metals for hydrogenation reactions. Bio2Amine™ is:

- a cofactor-free, heterogeneous biocatalyst
- shown to fully convert nitro to amine for over 35 compounds
- demonstrated excellent functional group tolerance (e.g. unsaturated bonds, halogens, sulphur).

HydRegen

For evaluation samples, email **products@hydregenoxford.com**

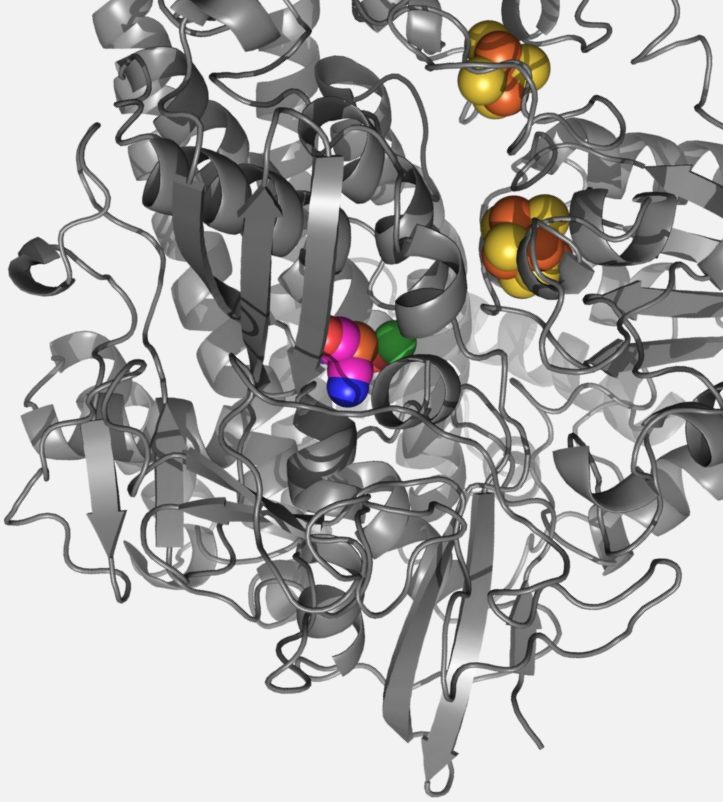
For further technical notes, visit **hydregenoxford.com**

HydRegen

Begbroke Science Park, Oxford,
OX5 1PF, U.K.

W: https://hydregenoxford.com

E: products@hydregenoxford.com



For more information get in touch

E: Products@hydregenoxford.com

We make biology operate like chemistry.

"Chemistry for biology"