



United States
Environmental Protection Agency

Office of Chemical Safety and
Pollution Prevention

**Final Risk Evaluation for
Asbestos
Part 1: Chrysotile Asbestos**

Systematic Review Supplemental File:

**Data Quality Evaluation of Environmental Fate
and Transport Studies**

December 2020

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Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	Common name and chemical formula provided.	1	2	2
	2. Test Substance Purity	Medium	Purity not provided but not likely to influence the study results.	2	1	2
Test Design	3. Study Controls	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	4. Test Substance Stability	Medium	Some details regarding the test substance homogeneity, preparation, and storage conditions were not reported but their omission is not likely to influence the study results.	2	1	2
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1

Study Reference:	Favero-Longo, SE; Turci, F; Tomatis, M; Castelli, D; Bonfante, P; Hochella, MF; Piervittori, R; Fubini, B. (2005). Chrysotile asbestos is progressively converted into a non-fibrous amorphous material by the chelating action of lichen metabolites. J Environ Monit 7: 764- 766. http://dx.doi.org/10.1039/b507569f . HERO ID: 3520647					
Test Organisms	9. Test Organism Degradation	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Outcome Assessment	11. Outcome Assessment Methodology	High	The ability of oxalic acid to transform chrysotile asbestos into an amorphous material was the desired outcome of interest and the methodology used was appropriate for that outcome.	1	1	1
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	Statistical methods were described in the Supporting Information of the publication and met the criteria for high confidence	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1

Study Reference:	Favero-Longo, SE; Turci, F; Tomatis, M; Castelli, D; Bonfante, P; Hochella, MF; Piervittori, R; Fubini, B. (2005). Chrysotile asbestos is progressively converted into a non-fibrous amorphous material by the chelating action of lichen metabolites. J Environ Monit 7: 764- 766. http://dx.doi.org/10.1039/b507569f . HERO ID: 3520647					
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	17	20	22
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.1	Overall Score (Rounded):	1.1
≥ 1 and < 1.7	≥ 1.7 and < 2.3	≥ 2.3 and ≤ 3			Overall Quality Level:	High ¹
¹ Some test details were obtained from the supporting material that was available in HERO (ID: 5353622)						

Study Reference: Schreier, H; Omueti, JA; Lavkulich, LM. (1987). Weathering Processes of Asbestos- Rich Serpentinic Sediments. Soil Sci Soc Am J 51: 993-999. HERO ID: 1917037						
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	2. Test Substance Purity	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Design	3. Study Controls	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	4. Test Substance Stability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test	Not rated	The metric is not	NR	NR	NR

Study Reference:	Schreier, H; Omueti, JA; Lavkulich, LM. (1987). Weathering Processes of Asbestos- Rich Serpentinic Sediments. Soil Sci Soc Am J 51: 993-999. HERO ID: 1917037					
	Organism Partitioning		applicable to this study type.			
Outcome Assessment	11. Outcome Assessment Methodology	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	12. Sampling Methods	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Confounding/ Variable Control	13. Confounding Variables	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	13	17	17
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1	Overall Score (Rounded):	1
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference:	Speil, S; Leineweber, JP. (1969). Asbestos minerals in modern technology. Environ Res 2: 166-208. HERO ID: 5353620					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The test substance was identified by chemical name.	1	2	2
	2. Test Substance Purity	Medium	The test substance source was not reported nor was the purity stated; however, the omissions were not likely to have a substantial impact on the study results.	2	1	2
Test Design	3. Study Controls	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	4. Test Substance Stability	Medium	The test substance stability, homogeneity, preparation or storage conditions were not reported; however, these factors were not likely to influence the test substance or were not likely to have a substantial impact on study results.	2	1	2
Test Conditions	5. Test Method Suitability	Medium	Details of the method were only summarized but are not likely to have a substantial impact on the results.	2	1	2
	6. Testing Conditions	Unacceptable	Testing conditions were not reported, and data provided were insufficient to interpret results.	4	2	8

Study Reference:	Speil, S; Leineweber, JP. (1969). Asbestos minerals in modern technology. Environ Res 2: 166-208. HERO ID: 5353620					
	7. Testing Consistency	Medium	Some test conditions across samples or study groups were not reported, but these discrepancies were not likely to have a substantial impact on study results.	2	1	2
	8. System Type and Design	Unacceptable	Details were not reported preventing meaningful interpretation of study results.	4	1	4
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Outcome Assessment	11. Outcome Assessment Methodology	Unacceptable	Study details were not reported to evaluate methodology.	4	1	4
	12. Sampling Methods	Medium	Details regarding sampling methods of the outcome(s) were not fully reported but were unlikely to have major impact on the results.	2	1	2
Confounding/ Variable Control	13. Confounding Variables	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR

Study Reference:	Speil, S; Leineweber, JP. (1969). Asbestos minerals in modern technology. Environ Res 2: 166-208. HERO ID: 5353620					
Data Presentation and Analysis	15. Data Reporting	Medium	The target chemical and transformation product(s) concentrations, extraction efficiency, percent recovery, or mass balance were not reported; however, these omissions were not likely to have a substantial impact on study results.	2	2	4
	16. Statistical Methods and Kinetic Calculations	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Other	17. Verification or Plausibility of Results	High	Reported values were within expected range.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	26	14	33
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	2.36	Overall Score (Rounded):	4
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	Unacceptable ¹
¹ Due to limited information assessing the results was challenging.						

Study Reference: Gronow, JR. (1987). The dissolution of asbestos fibres in water. Clay Miner 22: 21-35. https://doi.org/10.1180/claymin.1987.022.1.03 HERO ID: 5353542						
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The test substance was identified by common name.	1	2	2
	2. Test Substance Purity	Medium	The test substance source was reported. The purity of the test substance was not reported but this is unlikely to influence the study results.	2	1	2
Test Design	3. Study Controls	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	4. Test Substance Stability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR

Study Reference:	Gronow, JR. (1987). The dissolution of asbestos fibres in water. Clay Miner 22: 21-35. https://doi.org/10.1180/claymin.1987.022.1.03 HERO ID: 5353542					
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Outcome Assessment	11. Outcome Assessment Methodology	High	The outcome assessment methodology addressed the outcome of interest.	1	1	1
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	14	16	17
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.06	Overall Score (Rounded):	1.1
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference:		Choi, I; Smith, RW. (1972). Kinetic study of dissolution of asbestos fibers in water. J Colloid Interface Sci 40. http://dx.doi.org/10.1016/0021-9797(72)90014-8. HERO ID: 4140459				
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The test substance was identified by chemical name.	1	2	2
	2. Test Substance Purity	Medium	Source indicated but purity was not reported; however, the omission was not likely had to have an impact on the study results.	2	1	2
Test Design	3. Study Controls	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	4. Test Substance Stability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR

Study Reference:	Choi, I; Smith, RW. (1972). Kinetic study of dissolution of asbestos fibers in water. J Colloid Interface Sci 40. http://dx.doi.org/10.1016/0021-9797(72)90014-8. HERO ID: 4140459					
Outcome Assessment	11. Outcome Assessment Methodology	Medium	There were minor differences between the outcome assessment methodology and the outcome of interest; however, the difference does not likely have a substantial impact on the study results.	2	1	2
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	15	16	18
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.12	Overall Score (Rounded):	1.1
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference: Bales, RC; Morgan, JJ. (1985). Surface-charge And Adsorption Properties of Chrysotile Asbestos in Natural-Waters. Environ Sci Technol 19: 1213-1219. HERO ID: 3582724						
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The test substance was identified by common name.	1	2	2
	2. Test Substance Purity	Medium	The purity of the original ore was not provided; however, this omission was not likely to impact on the results.	2	1	2
Test Design	3. Study Controls	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	4. Test Substance Stability	High	The test substance is stable under the test conditions.	1	1	1
Test Conditions	5. Test Method Suitability	High	The test method was suitable for the test substance.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	Medium	Some system and design information were not reported, but the omissions were not likely to impact on the results.	2	1	2
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR

Study Reference:	Bales, RC; Morgan, JJ. (1985). Surface-charge And Adsorption Properties of Chrysotile Asbestos in Natural-Waters. Environ Sci Technol 19: 1213-1219. HERO ID: 3582724					
Outcome Assessment	11. Outcome Assessment Methodology	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	No confounding variables were reported.	1	1	1
	14. Outcomes Unrelated to Exposure	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	Calculations were described and assumptions used in their interpretation were also stated.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	15	16	18
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.12	Overall Score (Rounded):	1.1
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference:	Belanger, SE; Schurr, K; Allen, DJ; Gohara, AF. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and pathological stress. Environ Res 39: 74-85. HERO ID: 3584231					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The substance was identified by common name.	1	2	2
	2. Test Substance Purity	Medium	Purity and source of test substance not provided; however, it is not likely to affect the results of this study.	2	1	2
Test Design	3. Study Controls	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	4. Test Substance Stability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1

Study Reference:	Belanger, SE; Schurr, K; Allen, DJ; Gohara, AF. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and pathological stress. Environ Res 39: 74-85. HERO ID: 3584231					
Test Organisms	9. Test Organism Degradation	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	10. Test Organism Partitioning	Not rated	The metric is not applicable to this study type.	NR	NR	NR
Outcome Assessment	11. Outcome Assessment Methodology	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	Confounding variables were appropriately addressed.	1	1	1
	14. Outcomes Unrelated to Exposure	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Data Presentation and Analysis	15. Data Reporting	High	Data reporting was appropriate for this study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	17	21	22
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.05	Overall Score (Rounded):	1

Study Reference:	Belanger, SE; Schurr, K; Allen, DJ; Gohara, AF. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and pathological stress. Environ Res 39: 74-85. HERO ID: 3584231					
≥ 1 and < 1.7	≥ 1.7 and < 2.3	≥ 2.3 and ≤ 3			Overall Quality Level:	High

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Can J Fish Aquat Sci, 43: 43-52. HERO ID: 3093600					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	CAS number was not provided; however, the common name of the substance was used.	1	2	2
	2. Test Substance Purity	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Design	3. Study Controls	High	Blank groups were used which contained no asbestos and validated the test results.	1	2	2
	4. Test Substance Stability	High	The test substance preparation was reported and appropriate for the study.	1	1	1
Test Conditions	5. Test Method Suitability	High	The test method was suitable for the purpose of the study.	1	1	1
	6. Testing Conditions	High	Testing conditions were clearly reported and suitable for the study.	1	2	2
	7. Testing Consistency	High	Test conditions were consistent across study groups.	1	1	1
	8. System Type and Design	High	The system described was able to maintain substance concentrations.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	High	The test organism was described and appropriate for the study type	1	2	2

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Can J Fish Aquat Sci, 43: 43-52. HERO ID: 3093600					
Outcome Assessment	11. Outcome Assessment Methodology	High	The outcome assessment methodology was described clearly and reported the desired outcome.	1	1	1
	12. Sampling Methods	Medium	Accumulation rates were not derived due to sampling being done only at the end of the trials; however, this limitation did not have a substantial impact on the results.	2	1	2
Confounding/ Variable Control	13. Confounding Variables	High	No confounding variables were noted among study groups that would influence the outcome assessment.	1	1	1
	14. Outcomes Unrelated to Exposure	High	Exposure to asbestos caused decreased siphoning activity in all organisms to some degree. However, no health effects unrelated to exposure were noted.	1	1	1
Data Presentation and Analysis	15. Data Reporting	Medium	The method for measuring asbestos fiber levels in the whole-body homogenate, gill tissue, and visceral tissue were clearly described; however, no data was presented to demonstrate the accuracy of those methods. Considering that they were based on previously established methods in other literature, it is unlikely that this impacted the study results.	2	2	4
	16. Statistical Methods and Kinetic Calculations	High	Statistical analysis was described and included in the results.	1	1	1

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Can J Fish Aquat Sci, 43: 43-52. HERO ID: 3093600					
Other	17. Verification or Plausibility of Results	High	The reported values were reasonable.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	18	21	24
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.14	Overall Score (Rounded):	1.1
≥ 1 and < 1.7	≥ 1.7 and < 2.3	≥ 2.3 and ≤ 3			Overall Quality Level:	High

Study Reference:	Belanger, SE; Cherry, DS; Cairns J, JR. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile asbestos. Water Res 20: 1243-1250. HERO ID: 3093856					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	CAS number was not provided; however, common name was used.	1	2	2
	2. Test Substance Purity	Medium	Test substance purity was not stated but is not likely to impact the study results.	2	1	2
Test Design	3. Study Controls	High	Blank groups were used and had no detectable levels of asbestos	1	2	2
	4. Test Substance Stability	High	The test substance is stable under testing conditions	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	Testing conditions were clearly reported and suitable for the study method.	1	2	2
	7. Testing Consistency	High	Reported testing conditions were consistent across study groups.	1	1	1
	8. System Type and Design	High	The system type and design were capable of maintaining test substance concentrations.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
Outcome Assessment	11. Outcome Assessment	High	This metric met the criteria for high	1	1	1

Study Reference:	Belanger, SE; Cherry, DS; Cairns J, JR. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile asbestos. Water Res 20: 1243-1250. HERO ID: 3093856					
	Methodology		confidence as expected for this type of study.			
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	There were no confounding differences among the study groups that influenced the outcomes.	1	1	1
	14. Outcomes Unrelated to Exposure	High	No health outcomes unrelated to exposure were noted.	1	1	1
Data Presentation and Analysis	15. Data Reporting	High	The analytical method was suitable for detecting the test substance levels.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	17	21	22
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.05	Overall Score (Rounded):	1
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J; McGuire, MJ. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies. J Am Water Works Assoc 79: 69-74. https://doi.org/10.1002/j.1551-8833.1987.tb02817.x HERO ID: 3584230					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The substance was identified by common name.	1	2	2
	2. Test Substance Purity	High	The purity of the original ore was not provided; however, the authors noted that fibers were only identified as chrysotile if the characteristic TEM transmission patterns were seen and were considered "nonchrysotile fibers" if not.	1	1	1
Test Design	3. Study Controls	High	Blank groups were included in the laboratory exposure experiments and did not have detectable levels of asbestos.	1	2	2
	4. Test Substance Stability	High	The test substance is stable under the test conditions.	1	1	1
Test Conditions	5. Test Method Suitability	High	The test method was suitable for the test substance.	1	1	1
	6. Testing Conditions	Medium	Some testing conditions were omitted such as temperature and pH ranges, but these omissions are not likely to have a substantial impact on the results.	2	2	4
	7. Testing Consistency	High	There were no noted inconsistencies between the study groups.	1	1	1

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J; McGuire, MJ. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies. J Am Water Works Assoc 79: 69-74. https://doi.org/10.1002/j.1551-8833.1987.tb02817.x HERO ID: 3584230					
	8. System Type and Design	High	The system was capable of maintaining the concentration of the test substance.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR
	10. Test Organism Partitioning	High	The test organism was described and was suitable for the study type.	1	2	2
Outcome Assessment	11. Outcome Assessment Methodology	High	The outcome assessment methodology addressed the outcomes of interest.	1	1	1
	12. Sampling Methods	High	The sampling methods were adequate for the purpose of the study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	There were no confounding differences among study groups that influenced the outcome assessment. Also, uncertainty was provided in the concentration measurements for both the field and laboratory experiments.	1	1	1
	14. Outcomes Unrelated to Exposure	High	There were no differences in health outcomes between groups unrelated to exposure.	1	1	1
Data Presentation and Analysis	15. Data Reporting	Medium	No standard reference material was analyzed in order to test the accuracy of the analysis method; however, this omission was not likely to have had a substantial impact on the results.	2	2	4

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J; McGuire, MJ. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies. J Am Water Works Assoc 79: 69-74. https://doi.org/10.1002/j.1551-8833.1987.tb02817.x HERO ID: 3584230					
	16. Statistical Methods and Kinetic Calculations	High	Calculations were described clearly, and assumptions used in their interpretation were also stated.	1	1	1
Other	17. Verification or Plausibility of Results	High	The study results were compared to similar experiments done with other test organisms and were reasonable in comparison.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	18	21	25
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.19	Overall Score (Rounded):	1.2
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1990). Functional and pathological impairment of Japanese medaka (Oryzias latipes) by long-term asbestos exposure. Aquat Toxicol 17: 133-154. HERO ID: 3585046					
Domain	Metric	Qualitative Determination [i.e., High, Medium, Low, Unacceptable, or Not rated]	Comments	Metric Score	Metric Weighting Factor	Weighted Score
Test Substance	1. Test Substance Identity	High	The substance was identified using common name.	1	2	2
	2. Test Substance Purity	Medium	The purity of the original ore was not provided; but not likely to impact study results.	2	1	2
Test Design	3. Study Controls	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	4. Test Substance Stability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Conditions	5. Test Method Suitability	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	6. Testing Conditions	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	7. Testing Consistency	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	8. System Type and Design	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Test Organisms	9. Test Organism Degradation	Not rated	The metric is not applicable to this study type.	NR	NR	NR

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1990). Functional and pathological impairment of Japanese medaka (Oryzias latipes) by long-term asbestos exposure. Aquat Toxicol 17: 133-154. HERO ID: 3585046					
	10. Test Organism Partitioning	High	The test organism was described and was suitable for the study type.	1	2	2
Outcome Assessment	11. Outcome Assessment Methodology	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	12. Sampling Methods	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
Confounding/ Variable Control	13. Confounding Variables	High	There were no confounding differences among study groups that influenced the outcome assessment.	1	1	1
	14. Outcomes Unrelated to Exposure	High	There were no differences in health outcomes between groups unrelated to exposure.	1	1	1
Data Presentation and Analysis	15. Data Reporting	High	This metric met the criteria for high confidence as expected for this type of study.	1	2	2
	16. Statistical Methods and Kinetic Calculations	High	Calculations were described clearly, and assumptions used in their interpretation were also stated.	1	1	1
Other	17. Verification or Plausibility of Results	High	This metric met the criteria for high confidence as expected for this type of study.	1	1	1
	18. QSAR Models	Not rated	The metric is not applicable to this study type.	NR	NR	NR
			Sum of scores:	17	21	22
High	Medium	Low	Overall Score = Sum of Weighted Scores/Sum of Metric Weighting Factors:	1.05	Overall Score (Rounded):	1

Study Reference:	Belanger, SE; Cherry, DS; Cairns, J. (1990). Functional and pathological impairment of japanese medaka (oryzias-latipes) by long-term asbestos exposure. Aquat Toxicol 17: 133-154. HERO ID: 3585046					
≥1 and <1.7	≥1.7 and <2.3	≥2.3 and ≤3			Overall Quality Level:	High